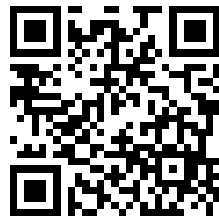

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EDITED BY

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ASSISTED BY

COLONEL D. HARVEY, C.M.G., C.B.E., R.A.M.C.

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(b) The organisms obtained from throat swab by culture on blood agar.

(c) Results of spleen palpation.

It is noticeable that malarial parasites hardly appear at all as findings in the tables dealing with severe, moderate and slight cases. The date of the last malarial attack is hardly a reliable evidence of malarial infection. The author does not succeed in discriminating between latent and active malaria as a concomitant factor, nor does he make his case against quinine, which, granted the correctness of the diagnosis, may be inefficient merely from non-absorption.

It is unquestionable that in such cases one or two intramuscular injections often succeed, and after that oral quinine seems to act more readily. It is equally well known that the gastro-intestinal tract is often involved in both diseases under review, in some cases indeed it dominates the clinical picture.

Study II.—The after-effects of the acute pulmonary complications of influenza as revealed by clinical, radioscopic and post-mortem examinations.

The author dwells on the importance of combined clinical, radioscopic and radiographic examinations during the period of convalescence. He insists on the frequency of bronchiectasis, fibroid changes, chronic pleurisy as sequelæ, so often considered the result of tubercular infection and the patients, as a result, sent to sanatoria.

A number of interesting cases with their interpretation is given to the reader. The importance of early breathing exercises in all cases of delayed resolution, non-tubercular, is rightly insisted upon. He advocates sterilization of the respiratory passages early in convalescence.

This study is most interesting to the clinician, especially to the beginner, who is apt to concentrate his mind too much on tubercular infection, to the exclusion of many other morbid conditions. It brings once more to our mind the necessity for the closest co-operation between the clinician and the pathologist.

Study III.—The epidemic as it affected the hospital nursing staff:—

This study makes sad reading, and is an incentive to the student in preventive medicine. Of a total of 329 nurses and 49 maids in residence, no less than 84 of the former and 21 of the latter contracted the disease between September 22, 1918, and April 3, 1919, with an average of 4 daily casualties during one period. The author makes out the following points:—

(1) Ward infection was common. The duration of contact was on an average longer for nurses attending serious cases in medical wards than in surgical wards; also, nurses employed in wards for slight and moderate cases generally were infected after a shorter period of contact.

(2) Fatal cases among nurses were traceable to fatal cases nursed. A case of acute broncho-pneumonia is mentioned, which was apparently responsible for the death of two nurses, the chaplain and the aural surgeon.

(3) Previous attacks, if recent, conferred a certain degree of immunity on the nursing staff.

(4) The maids who were not working in the wards, showed a higher incidence of infection and contracted a more severe type.

The author rightly attaches importance to nasal douching and gargling as preventives, but no mention is made of the value or otherwise of preventive inoculation, if judiciously carried out at an interval of three to four weeks before contact.

The slow and automatic process of immunization incidental on daily contact coupled with the higher standard (hygienic) of living in the case of the nurses may explain why they generally fared better than the maids.

The author's statement on page 78, to the effect that "many more cases of influenza than is generally believed have at their onset a nidus infection in the lungs," may mislead the student and even the general practitioner in the sense that the very important primary localization in the naso-pharyngeal region may be

completely overlooked at a time when treatment directed to these parts must make a material difference to the patient and those in his immediate neighbourhood. It is practically certain that the lung infection is secondary to the above, from which it proceeds by the lymph paths or blood-stream and not by direct inhalation, but possibly by direct downward extension.

J. E. H. G.

A SYNOPSIS OF MEDICINE. By H. Letheby Tidy, M.A., M.D., B.Ch.Oxon., F.R.C.P.Lond. Bristol: J. Wright and Sons. Second Edition. Cr. 8vo, Pp. 972. 25s. net.

The manner in which this excellent synopsis has been appreciated is shown by the appearance, in about eighteen months, of a second edition.

The only serious revision that has been undertaken is of the portion dealing with encephalitis lethargica, which instead of occupying nine lines as formerly is now more adequately summarized in a chapter of four pages.

LECTURES ON THE SURGERY OF THE STOMACH AND DUODENUM. By James Sherren, C.B.E., F.R.C.S. London: H. K. Lewis and Co., Ltd., 1921. Pp. 96. Price 4s. 6d.

The author has conferred a real benefit to the profession by the publication of these seven lectures delivered to the students of the London Hospital in 1920—1921.

We have not seen, within the same compass, such a masterly review of the pathology, symptoms and diagnosis of the surgical affections of the stomach and duodenum.

Too much stress cannot be laid on the contention of the author, that it is the history of the case which gives us our best guide to the diagnosis, and, that apart from the cases where gross tumour or secondary deposits are present, physical signs may be entirely negative.

He gives a further necessary warning regarding the dangers of accepting a negative X-ray result as sufficient reason for refusing operation if the history and signs point to a surgical lesion.

The occurrence of malignant disease as a sequel of chronic ulcer of the stomach is strongly emphasized and the change in the character of the symptoms when malignancy has occurred is well shown.

From the point of view of the student it is hoped that the author may see his way to include in future editions a comparative table of the signs and symptoms of the various affections described. From the point of view of the surgeon we regret that there is no description of the actual technique employed by the author in the various surgical procedures advocated.

We specially recommend this little book to the physician and general practitioner as a warning against the continued treatment by medical means alone of cases of recurrent dyspepsia or dyspepsia which resists rest in bed and medicinal treatment. As the author points out, in the large majority of cases of carcinoma of the stomach where operation is likely to be beneficial the diagnosis can only be made by exploratory laparotomy. We also agree with his contention that we ought not to be satisfied with the diagnosis of appendix dyspepsia until we have examined the stomach and duodenum at operation.

The little book is well produced by the publishers, excellently printed and free from errors.

J. W. W.

INDEX TO VOLUME XXXVIII.

C.N. = Clinical and other Notes.
C.L. = Current Literature.

	PAGE		PAGE
Agate, Major H. St A., and L. S. A., the standardization of a base culture medium	163	Boyd, Major J. E. M., entomological notes C.N.	459
Agate, L. St. A., the standardization of a base culture medium	163	Boyd, Major J. E. M., On a Muscid fly breeding on a ship at sea, entomological notes C.N.	378
Alexandra, Captain R. H., notes on cases of heatstroke occurring in British troops at Basra	358	Boyd, Major J. E. M., the botany and natural history of the dyke-land near Sandwich	41, 117
Ambulance, field, in Anatolia, by Major R. E. Barnsley	267	Cathcart, E. P., and Captain A. G. Stevenson, energy expenditure in man, the cost of positive, negative and static work	1
Ambulance, field, suggestions for a new establishment for a, by Captain G. P. Kidd C.N.	59	Child at school; the physical training of the, by Lieutenant-Colonel R. Tate ..	189
Anatolia, a field ambulance in, by Major R. E. Barnsley	267	Clark, Col. S. F., a visit to the Roman wall	465
Anderson, Major A. Greig, malaria in Macedonia	25	Convalescent Depot as a Permanent Peace Organization, by Major G. R. Painton	106, 289
Auricular fibrillation, the quinidine treat- ment of, by Major J. H. Spencer C.N.	374	Convulsions treated with luminal, report of a case of, in a child, by Colonel G. T. Rawnsley C.N.	222
Austrian Tyrol, a short winter sports holiday in the, by Major R. C. Wilson	381	Convulsions treated with luminal, report of a case, in a child, by Colonel G. T. Rawnsley, letter from C.N.	400
<i>Bacillus diphtheriae</i> , the serological differ- entiation of some strains of, by Major A. S. G. Bell	48	Coppinger, Major F. B., preliminary experiments with a view to the prepara- tion of a non-toxic dysentery vaccine..	243
Balfour, Andrew, with a fish spear on the reefs	387	CORRESPONDENCE—	
Barnsley, Major R. E., a field ambulance in Anatolia	267	Appreciation of Major-General Sir George Evatt, letter from Major- General W. Donovan	81
Beamish, Captain D. W., notes on the Wassermann reaction carried out on an unselected British military garrison C.N.	376	Hæmatophagy in typhus fever, by H. M. Woodcock	81
Bell, Major A. S. G., the serological differentiation of some strains of <i>Bacillus diphtheriae</i>	48	Malaria in Palestine, by Major N. Low	401
Beriberi, occurring amongst British troops during a voyage from India to France, by Major J. E. M. Boyd C.N.	303	Physical training in the Army, by Lieutenant-Colonel F. W. Cotton	161
Bilbarzia hæmatobia, notes on a case of sporadic non-imported, by Captain S. Smith C.N.	309	Report on a case of convulsions treated with luminal, by Colonel G. T. Rawnsley	400
Bowie, Lieutenant D. C., three unusual cases of fracture of the humerus C.N.	377	Tick fever in East Persia, by C. H. H. Harold	399
Boyd, Major J. E. M., beriberi occurring amongst British troops during a voyage from India to France C.N.	303	Cotton, Lieutenant-Colonel F. W., physical training in the Army ..	161

	PAGE		PAGE
Culture medium, the standardization of a base, by Major H. St. A. Agate and L. St. A. Agate	163	Gas Warfare, by Major W. E. Galwey, lecture	62, 144, 223, 309
Diarrhoea, infantile, by Captain G. H. Wood	C.N. 218	Gases, chronic effects of inhalation of suffocating, by Captain A. Mearns ..	350
Dive, Major G. H., a case of paratyphoid A fever	C.N. 306	Gask, G. E., sick and wounded, care of, during Marlborough's march, in 1704	274
Donovan, Major-General Sir W., appreciation of Major-General Sir George Evatt, letter from	81	Gonococcal infection, a case of severe systemic, by Captain G. H. Wood	C.N. 218
Dudding, Lieutenant-Colonel J. S., report on an outbreak of food poisoning at Larkhill	C.N. 138	Gray, Major A. C. H., a method of memorizing a map	C.N. 460
Dyke-land near Sandwich, the botany and natural history of the, by Major J. E. M. Boyd	41, 117	Gray, Major A. C. H., mobile laboratories	323
Dysentery, vaccine, the preparation of a non-toxic, by Major F. R. Coppinger and Captain R. C. Robertson	243	Hæmatophagy and hæmetaboly as a normal function of various types of tissue cell, by H. M. Woodcock ..	403
ECHOES FROM THE PAST—		Hæmatophagy in typhus fever, by H. M. Woodcock, letter from	81
A visit to the Roman wall, by Col. S. F. Clark	465	Harold, Captain C. H. H., tick fever in East Persia, letter from	398
Encephalitis in Rome, epidemic, pathology and bacteriology of	C.L. 237	Heart, the, in examining recruits and soldiers for discharge, by K. R. Smith	207
Energy expenditure in man, by Professor E. P. Cathcart and Captain A. G. Stevenson	1	Heatstroke occurring in British troops at Basra, by Capt. R. H. Alexander ..	358
Evatt, Major-General Sir George, appreciation of, letter from Major-General W. Donovan	81	Henderson, Lieutenant-Colonel P. H., the problem of stamping out venereal diseases	445
Fibrillation, the quinidine treatment of auricular, by Major J. H. Spencer	C.N. 374	HISTORICAL NOTES—	
Field ambulance, suggestions for a new establishment for a, by Captain G. P. Kidd	C.N. 59	A brief account of Millbank Penitentiary	468
Firth, Colonel Sir Robert, fragments	189, 427	Holotrichous ciliate pathogenic to <i>Theobaldia annulata</i> Schrank, by Lieutenant-Colonel W. P. MacArthur	83
Fish spear on the reefs, with a, by Andrew Balfour	387	Humerus, unusual cases of fracture of the, by Lieutenant D. C. Bowie	C.N. 377
Fly breeding on a ship at sea, entomological notes on a muscid, by Major J. E. M. Boyd	C.N. 378	Kala azar, note on three cases of infantile, by Major R. E. U. Newman ..	C.N. 379
Food poisoning at Larkhill, report on an outbreak of, by Lieutenant-Colonel J. S. Dudding	C.N. 138	Kennedy, Lieutenant-Colonel J. C., a case of paratyphoid A fever, a note on	C.N. 306
Formalin reaction for syphilis, serums tested by the, by W. Leslie Webb	C.N. 54	Kidd, Captain G. P., suggestions for a new establishment for a field ambulance	C.N. 59
Fracture of the humerus, unusual cases of, by Lieutenant D. C. Bowie	C.N. 377	Laboratories, mobile, by Major A. C. H. Gray	323
Fragments, by Colonel Sir Robert Firth	189, 427	Large, Major D. T. M., Sachs-Georgi reaction	C.N. 213
Galwey, Major W. E., gas warfare, lecture	62, 144, 223, 309	LECTURES—	
		Gas Warfare, by Major W. E. Galwey	62, 144, 223, 309
		Load carried by the soldier, by Major N. V. Lothian	9
		Lothian, Major N. V., the load carried by the soldier	9

	PAGE		PAGE
Loughnan, Major W. F. M., notes on a case of myiasis C.N.	458	Paratyphoid A fever, a case of, by Major G. H. Dive and Lieutenant-Colonel J. C. Kennedy C.N.	306
Low, Major N., malaria in Palestine, letter from	401	Perry, Brevet Lieutenant-Colonel H. Marrian, and Major E. C. Lambkin, report made on a comparison of the Sigma and Wassermann reactions ..	440
Luminal, report of a case of convulsions in a child treated with, by Colonel G. T. Rawnsley C.N.	222	Pfeiffer's bacillus, incidence of infection with, before, during and after 1918 epidemic C.L.	393
Luminal, report of a case of convulsions in a child treated with, letter from Colonel G. T. Rawnsley	400	Physical training in the Army, by Lieutenant-Colonel F. W. Cotton, letter from	161
MacArthur, Lieutenant-Colonel W. P., a holotrichous ciliate pathogenic to <i>Thebaldia annulata</i> Schrank	83	Physical training of the child at school, by Lieutenant-Colonel R. Tate ..	189
Macdonald, Major Angus, a note on the physical estimate of malarial disability C.N.	181	Pneumonia-producing group of organisms, transmission of the C.L.	394
McKinstry, W. H., a serological investigation of oriental sore C.N.	216	Pneumococcus, serological and morphological characteristics of the, by Major A. L. Urquhart	171
McLay, Captain Kenneth, malaria in Macedonia	93	Poisoning, food, at Larkhill, report on an outbreak of, by Lieutenant-Colonel J. S. Dudding C.N.	138
Macedonia, malaria in, by Major A. Greig Anderson, Captain Kenneth McLay, Captain T. S. Hele, Captain J. Waterston 25, 93, 251,	334	Pratt, Captain W. W., observations on agglutinin response following inoculation of a mixed vaccine C.N.	296
Malaria C.L.	72, 155	Quinindine treatment of auricular fibrillation, by Major J. H. Spencer C.N.	374
Malaria disability, a note on the physical estimate of, by Major Angus Macdonald	181	Rawnsley, Colonel G. T., report of a case of convulsions in a child treated with luminal C.N.	222
Malaria in Macedonia, by Major A. Greig Anderson, Captain Kenneth McLay, Captain T. S. Hele, Captain J. Waterston 25, 93, 251,	334	Rawnsley, Colonel G. T., report of a case of convulsions in a child treated with luminal, letter from	400
Malaria in Palestine, by Major N. Low, letter from	401	Recruits and soldiers for discharge, the heart, in examining, by K. R. Smith ..	207
Manifold, Major J. A., observation on agglutinin response following inoculation of a mixed vaccine C.N.	296	Relapsing fever C.L.	234
Marlborough's march in 1704, care of the sick and wounded, by G. E. Gask ..	274	REVIEWS—	
Mearns, Captain A., chronic effects of inhalation of suffocating gases	350	A synopsis of medicine, by H. L. Tidy ..	474
Millbank Penitentiary, an account of ..	468	A text-book of general pathology, by Beattie and Dickson	77
Muscid fly breeding on a ship at sea, entomological notes on, by Major J. E. M. Boyd C.N.	378	Lectures on the surgery of the stomach and duodenum, by James Sherren ..	474
Myiasis, notes on a case of, by Major W. F. M. Loughnan C.N.	458	Manic-depressive insanity and paranoia, by Prof. E. Kraepelin	159
Newman, Major R. E. U., note on three cases of infantile kala azar C.N.	379	Medical history of the war	80
Oriental sore, a serological investigation of, by W. H. McKinstry C.N.	216	Notes on law and procedure as applied to courts-martial	472
Painton, Major G. P., the Convalescent depot as a permanent peace organization	106, 289	Radiographic technique, by T. Thorne Baker	160
		Studies on influenza and its pulmonary complications, by D. Barty King ..	472
		Symptomatology, psychognosis and diagnosis of psychopathic diseases, by Boris Sidis	79

REVIEWS—continued.		PAGE			PAGE
Syphilis and venereal diseases, by C. F. Marshall and E. G. French ..	78		Stevenson, Captain A. G., energy expenditure in man	1	
Text-book of tracheo-bronchoscopy, by Dr. M. Mann	159		Stirling, Major H. D., the International Congress of Military Medicine and Pharmacy	C.N.	462
The ætiology and pathology of typhus ..	396				
<i>The Burma Medical Times</i>	160				
The diary of a Yeomanry medical officer, Egypt, Gallipoli, Palestine and Italy, by Captain O. Teichman	77		Tate, Lieutenant-Colonel R., the physical training of the child at school	189	
The lethal war gases, physiology and experimental treatment, by Frank P. Underhill	238		Tick fever in East Persia, letter from Captain C. H. H. Harold	398	
The prevention of malaria in the Federated Malay States, by M. Watson ..	396				
The spleen and some of its disorders, by Sir Berkeley Moynihan	79		TRAVEL—		
The story of the Horton War Hospital, by Lieutenant-Colonel J. R. Lord ..	238		A short winter sports holiday in the Austrian Tyrol, by Major R. C. Wilson	381	
The Wassermann test, by Chas. F. Craig ..	77				
Therapeutic immunization in asylum general practice, by W. Ford Robertson	240		Urquhart, Major A. L., serological and morphological characteristics of the pneumococcus	171	
Robertson, Captain R. C., the preparation of a non-toxic dysentery vaccine ..	243				
Royal Army Medical Corps, from a junior officer's standpoint, by Captain H. G. Winter	367		Venereal diseases, the problem of stamping out, by Lieutenant-Colonel P. H. Henderson	445	
Sachs-Georgi reaction, by Lieutenant-Colonel J. L. Wood, and Major D. T. M. Large	C.N.	213			
Sick and wounded, care of, during Marlborough's march in 1704, by G. E. Gask ..	274		Wassermann and Sigma reactions, a comparison of the, by Brevet Lieutenant-Colonel H. Marrian Perry and Major E. C. Lambkin	440	
Sigma and Wassermann reactions, a comparison of the, by Brevet Lieutenant-Colonel H. Marrian Perry and Major E. C. Lambkin	440		Wassermann reaction, carried out on an unselected British military garrison, by Captain D. W. Beamish	C.N.	376
Smith, K. R., the heart, in examining recruits and soldiers for discharge ..	207		Webb, W. Leslie, one thousand one hundred and seventy-three serums tested by the formalin reaction for syphilis	C.N.	54
Smith, Captain S., Bilharzia hæmatobia, notes on a case of sporadic non-imported	C.N.	300	Wilson, Major R. C., a short winter sports holiday in the Austrian Tyrol	381	
Soldier, the load carried by the, by Major N. V. Lothian	9		Winter, Captain H. G., the Royal Army Medical Corps from a junior officer's standpoint	367	
Soldiers and recruits for discharge, the heart in examining, by K. R. Smith ..	207		Wood, Captain G. H., a case of severe systemic gonococcal infection	C.N.	218
Sore, Oriental, a serological investigation of, by W. H. McKinstry	C.N.	216	Wood, Captain G. H., infantile diarrhoea	C.N.	219
Spencer, Major J. H., the quinidine treatment of auricular fibrillation ..	C.N.	374	Wood, Lieutenant-Colonel J. L., Sachs-Georgi reaction	C.N.	213
SPORT—			Woodcock, H. M., hæmatophagy and hæmetaboly as a normal function of various types	403	
With a fish spear on the reefs, by Andrew Balfour	387		Woodcock, H. M., hæmatophagy in typhus fever, letter from	81	
			Wounded and sick, care of, during Marlborough's march in 1704, by G. E. Gask	274	

Journal
of the
Royal Army Medical Corps.

Original Communications.

**ENERGY EXPENDITURE IN MAN : THE COST OF POSITIVE,
NEGATIVE AND STATIC WORK.**

By PROFESSOR E. P. CATHCART, F.R.S., and CAPTAIN A. G. STEVENSON, R.A.M.C.
Physiology Institute, University of Glasgow.

PRELIMINARY COMMUNICATION.

LINDHARD [1] in a recent paper has clearly stated the problem of work from a physiological standpoint. He writes: "In physiology one speaks of work, when as the result of a stimulus bound chemical energy is liberated. If a muscle is stimulated the bound chemical energy is converted partly into heat and partly into the energy of tension. This tension energy can in turn be converted according to external conditions into positive and negative work in the physical sense of the words; that is if it be a movement in the direction of the pull of the muscles (work by shortening) or in the opposite direction (work by lengthening) or finally the movable parts may be fixed in a definite position. This latter form of work is called static." He has also quite properly pointed out that under ordinary conditions of contraction all three types of "work" are involved. When work is done, it is true, shortening may take place of certain muscles but at the same time lengthening of others takes place simultaneously, and others on the other hand act statically. Further the ordinary voluntary muscle contraction is not a simple single contraction but a tetanus of varying duration. Hence it is impossible ever strictly to differentiate between the positive and negative work at least. Static work on the other hand owing to its nature can be more specifically differentiated.

As positive and negative work both contain the same elements of contraction, it is probable that provided the two types of work are each

carried out slowly the cost of performance will not materially differ. In the present communication, the two types of work are compared when carried out at the same comparatively rapid rate. This aspect of the question was dealt with first, as in military work the whole aim of the training is to produce sharp precise movements, staccato rather than legato, so that the drill is smart and "soldier-like." Static work, although as such it is only practised occasionally in army training, for example, in presenting arms, has also been briefly dealt with. Although in the present preliminary communication no great stress has been laid upon static work, this is a type of activity which cannot be neglected: in fact, it is suggested that the severity or hardness of muscle work, *qua the organism as a whole*, is a function of the static component of the work done.

Previous Work.—Various researches have been carried out on the relative expenditure of energy while doing positive work, i.e., the actual raising of a definite weight through a definite distance and the relation to it of the lowering of the same weight through the same distance, or of negative work. These investigations have been confined for the most part to leg muscles in raising or lowering the weight of the body. Thus Zuntz who studied the question from a mountaineering point of view has stated that the purely vertical downward movement of one kilogram through the distance of one metre, involves the expenditure of about forty to forty-five per cent of the cost of the positive work of raising the same mass through the same distance. Chauveau [2] carried out a series of experiments on man on the "roue de Hirn," during which he estimated the energy expended in ascending and descending over various distances and carrying various weights. His results, which of course relate to the leg muscles only, show when averaged, that the cost of the performance of negative work is about fifty-two per cent of that involved in the performance of positive work, in this instance the lowering or raising of fifty kilograms through a distance of 431 metres. Johansson [3] and Johansson and Koraen [4] have also investigated the cost of all three types of work by the use of a special ergometer, but they made no direct comparison between the different forms. Their particular interest was the relation of the extent of the increase in metabolism, as estimated by the carbon dioxide output, to the work done.

The preliminary experiments recorded in the present paper deal, with one exception, with arm movements only. An attempt was made to estimate, in the positive and negative phases of work, whether a purely flexor action was done in a more economical manner than an extensor one, i.e., what was the cost relationship between raising a given weight through a given distance and the lowering of the same weight through the same distance, employing in the first instance the flexors of the arm and in the second the extensors. Also, as indicating a half-way position between positive and negative work, the cost of purely static arm work was estimated. Finally, although time did not permit of entering more fully into these

interesting relationships, a short experiment was done on the relative energy expenditure of one commonly used muscle group, e.g., the flexors of the thigh as against a group less frequently brought into action, e.g., the abductors of the thigh.

These investigations were carried out on a single subject and the conditions were standardized as far as possible. Thus no estimation was done until from three to three and a half hours after a light meal (mixed diet) and the conditions inside the laboratory were not allowed to vary to any extent.

A series of estimations were made in the first instance on the resting metabolism of the subject so that the net value of the work performed could be gauged. Then the various phases of negative and positive work were carried out. In all these, except in the basal and static experiments, a period of at least three minutes was allowed to elapse after the start of the work to be done before the expired air was collected in the Douglas bag, the subject being presumed then, as the work was not very onerous, to have "warmed" to the work.

The indirect method of estimating the energy expenditure was employed, using the apparatus and technique already detailed by one of us [5].

Subject S., aged 30. Height 182 centimetres. Weight 82.5 kilograms. Surface area 2.04 square metres.

(1) *Resting Metabolism*.—The subject was kept at complete rest for forty minutes and the expired air then collected for a period of eight minutes. A series of preliminary experiments were carried out until the subject became accustomed to the technique. The results (Table I) obtained show that an approximately normal physiological subject was being dealt with.

TABLE I.

Per minute		R. Q.	Per hour.	
Oxygen c.c.	CO ₂ c.c.		Calories	Calories per sq. metre
294 ..	247 ..	0.84 ..	85.5 ..	41.9
295 ..	245 ..	0.83 ..	85.6 ..	41.9
283 ..	206 ..	0.73 ..	80.0 ..	39.2
276 ..	199 ..	0.72 ..	77.8 ..	38.1
280 ..	200 ..	0.72 ..	78.9 ..	38.7

} 39.96 mean value

A variance in the respiratory quotient and calorie value is, as one would expect, present in these estimations as the previous meal was not constant in composition. The mean value of the series, 39.96 calories per square metre per hour approximates, however, very closely to the standard basal metabolism as determined by the American workers, viz., 39.7 calories.

(2) *The Relation between the Expenditure involved in raising and lowering a Weight of Fifteen Kilograms, through Fifty Centimetres at a Fixed Rate of Speed using the Flexors of the Arm*.—The subject, standing upright, raised with both arms, to the set beat of a metronome, a fifteen kilogram weight through a distance of half a metre. The special handle of the weight was gripped by the hands with the palms upwards thus giving an almost purely flexor action in raising. An assistant as soon as the weight

was placed on the higher plane returned it to its former position. The estimation of the energy expenditure in the performance of this work gave the positive cost. For the negative phase the method of operation was reversed, the assistant raising and the subject lowering the weight. The speed at which the work was done was the same as with positive work. The rate employed was one lift or lowering every four seconds.

The expenditure of the combined movements of raising and lowering the weight at the same speed as before was also determined, as also the cost of moving the arms without the weight through the same distance.

TABLE II.

Positive Work.—Flexors.							
Per minute			R.Q.	Per hour			
Oxygen c.c.	CO ₂ c.c.			Calories	Calories per sq. metre		
1144	..	923	0.81	330	..	161.0	150.9 mean
1075	..	815	0.76	306	..	150.0	
1042	..	835	0.80	300	..	147.0	
1055	..	867	0.82	305	..	149.7	
1036	..	839	0.81	279	..	146.7	
Negative Work.—Flexors.							
935	..	770	0.81	270	..	132.0	124.5 mean
933	..	753	0.81	269	..	131.8	
900	..	718	0.81	259	..	127.4	
857	..	660	0.74	243	..	119.0	
871	..	610	0.71	241	..	118.0	
851	..	638	0.75	242	..	118.6	
Positive and Negative Work combined.—Flexors.							
1293	..	1009	0.78	370	..	181	180.5 mean
1282	..	1023	0.80	369	..	180	
Positive and Negative Arms Movements alone (without weight).—Flexors.							
467	..	327	0.71	131	..	64.0	60.1 mean
403	..	302	0.75	114	..	56.1	
421	..	318	0.76	120	..	58.7	
442	..	329	0.75	126	..	61.5	

These results can be considered in the following different ways:—

- (1) Relation of Positive to Negative Work in Total Expenditure,
i.e., $\frac{P}{N} = \frac{150.9}{124.5}$ or approx. $\frac{100}{82}$
- (2) Expenditure less Basal Metabolism (39.96 cal.) or Net Expenditure,
i.e., $\frac{P}{N} = \frac{110.94}{84.54}$ or approx. $\frac{100}{76}$
- (3) Expenditure less Arms Movements (without weight 60.1 cal.),
i.e., $\frac{P}{N} = \frac{90.8}{64.4}$ or approx. $\frac{100}{71}$
- (4) Expenditure on Positive and Negative work combined as against Positive and Negative work performed separately,
i.e., $\frac{P + N \text{ (combined)}}{P + N \text{ (singly)}} = \frac{180.5}{150.9 + 124.5} = \frac{180.5}{275.4}$
less Arms Movements 60.1 cal. = $\frac{120.4}{155.2} =$ or approx. $\frac{77}{100}$

It will be noticed that the values in the various experiments tend to decrease on the whole from the first estimation to the last in each series. This is in all probability due to the fact that the muscles are becoming trained to perform the necessary movements in the most economical fashion but, as this factor is present in all the experiments, it is a common one and does not therefore affect the relative values. These results show that purely negative work is performed at a definite cost, which cost, moreover, in relation to positive work, is fairly high. Also that the cost of the combined movements of lowering and raising is lower than the value obtained by adding together the single values of each movement.

(3) *The Relation between the Expenditure involved in raising and lowering a Weight of Fifteen Kilograms through Fifty Centimetres at a Fixed Rate of Speed using the Extensors of the Arm.*—This experiment was similar to the foregoing with exception of the different muscles employed and the necessary changes entailed in the apparatus. The muscles used were the extensors of the arm, and to obtain their action the weight was attached to a rope running over a pulley fixed to a beam overhead, the other end of the rope having a cross handle attached. The raising movement was thus an action depressing the cross handle, in this way bringing the extensors of the arm into play. Once raised the exact distance an assistant gripped the weight and lowered it back to the starting point to be again raised by the subject. The distance to be travelled was measured out on the rope and buffers were attached to limit this to the exact length, fifty centimetres. Negative work was again a reversal of the positive process. The speed at which the work was performed was the same as in the previous flexor movement.

TABLE III.

Positive Work.—Extensors.

Per minute				R.Q.	Per hour		
Oxygen c.c.	Co ₂ c.c.				Calories	Calories per sq. metre	
879	675	..	0.77	..	251	123.0	} 115.0 mean
820	676	..	0.82	..	238	116.5	
853	603	..	0.71	..	226	110.6	
812	633	..	0.78	..	233	114.0	

Negative Work.—Extensors.

690	501	..	0.73	..	195	95.5	} 84.0 mean
638	453	..	0.71	..	180	88.0	
575	436	..	0.76	..	164	80.3	
566	418	..	0.74	..	160	78.6	
562	403	..	0.72	..	158	77.7	

Positive and Negative Work combined.—Extensors.

885	642	..	0.76	..	241	118.0	} 117.1 mean
852	690	..	0.81	..	246	120.6	
802	608	..	0.76	..	230	112.6	

Expenditure of arms movements alone was taken as in Table II, viz., 60.1 calories. Calculating as before the values are as follows:—

$$(1) \frac{P}{N} = \frac{115}{84} \text{ or approx. } \frac{100}{73}$$

$$(2) \text{ Less Basal Metabolism } \frac{P}{N} = \frac{75.04}{44.04} \text{ or approx. } \frac{100}{59}$$

$$(3) \text{ Less Arms Movements } \frac{P}{N} = \frac{54.9}{23.9} \text{ or approx. } \frac{100}{44}$$

$$(4) \frac{P + N \text{ (combined)}}{P + N \text{ (singly)}} = \frac{117.1}{199.0} = \text{less Arms Movements } \frac{57}{78.8} \text{ or approx. } \frac{72}{100}$$

Comparing the figures with those obtained in the previous experiment the work was, as a whole, both positive, negative and combined, done at a less cost. To what extent this reduction in cost was due to the fact that the weight was handled in these experiments in an easier manner has not been determined. Subjectively the work was undoubtedly more easily carried out. The relationship between the positive and negative phases tends to show that a purely negative extensor movement in relation to the positive expenditure is more economical than a purely negative flexor movement. The combined movements again showed greater economy over the movements calculated singly, and was indeed little more than a few calories in excess of the positive work alone. Tabulating these values for flexor and extensor actions in the four different ways we get:

	(1)	(2)	(3)	(4)
Flexor movements ..	$\frac{P}{N} = \frac{100}{82}$	$\frac{100}{76}$	$\frac{100}{71}$	$\frac{77}{100}$
Extensor movements ..	$\frac{P}{N} = \frac{100}{73}$	$\frac{100}{59}$	$\frac{100}{44}$	$\frac{72}{100}$

(4) *The Expenditure of Energy involved in Static Work by the Arms.*—This estimation was carried out by keeping suspended in the air the fifteen kilogram weight. The subject stood in an upright position and grasped the handle attached to the pulley rope with arms stretched forwards so that only the arm muscles were involved in the maintenance of the weight. On account of the difficulty in maintaining this position for the usual period of collection of the expired air, three minutes preparatory and four minutes collection, the period was reduced to two plus three minutes. Even this shortened period was borne with difficulty. Previous observers, like Johansson and Lindhard, also found this type of work very exhausting. Lindhard, who has studied the question in greatest detail, found that the maximum increase in oxygen consumption took place after the cessation of work, which, in his experiments, was of very short duration. Unfortunately, this point was not investigated in the present series of experiments. The fact that the cost appears to be low in spite of the intense subjective feeling of fatigue would perhaps support Lindhard's contention.

TABLE IV.

Static Arm Work.							
Per minute		R.Q.		Per hour			
Oxygen c.c.	Co ₂ c.c.			Calories		Calories per sq. metre	
702	642	..	0.91	..	208	..	102.0
615	570	..	0.93	..	183	..	89.5
682	577	..	0.85	..	199	..	97.4
637	498	..	0.78	..	183	..	89.5
} 94.6 mean							
Static Position—Arms Outstretched without Suspending Weight.							
412	292	..	0.71	..	116	..	56.7

Comparing these values with those obtained with lifting and lowering the same weight the following interesting relations are obtained:—

$$\begin{aligned}
 (1) \text{ Static} &= 94.6 \text{ or approx. } 82 \\
 \text{Lifting} &= 115.0 \text{ } \frac{82}{100} \\
 (2) \text{ Static} &= 94.6 \text{ or approx. } 113 \\
 \text{Lowering} &= 84.0 \text{ } \frac{113}{100} \\
 (3) \text{ Static} &= 94.6 \\
 \frac{\text{Lifting} + \text{lowering}}{2} &= \frac{115 + 84}{2} = 99.5 \text{ or approx. } \frac{95}{100}
 \end{aligned}$$

A static action, as above, would therefore appear to be performed at a cost nearly half way between the calculated combined costs of the raising and lowering movements and, speaking generally, at a comparatively low cost as regards the subjective muscular fatigue which is produced.

(5) *The Relation between the Expenditure involved in the use of the Flexor and Abductor Groups of Muscles of the Thigh.*—These two groups of muscles were chosen as representing a group in common use as against a group less frequently employed to determine the economy, if any, of a trained over a partly-trained movement. The method of investigation was as follows: (a) Flexors. The subject standing upright flexed the leg at the thigh keeping the limb straight until a certain measured angle was traversed. This was limited to a fixed distance by the toe striking a specially placed buffer. The leg was then brought back to the starting line and again flexed and so on. The rate was one flexion per second (to the beat of a metronome) and right and left legs were used alternately in series of ten movements each. (b) Abductors. The same method was employed, the abduction movement traversing a similar angle and being regulated by the side of the foot striking a suitably placed buffer, using again alternate legs in series of ten movements and at the same rate as before.

TABLE V.

Movement of Flexion.							
Per minute		R.Q.		Per hour			
Oxygen c.c.	Co ₂ c.c.			Calories		Calories per sq. metre	
625	485	..	0.78	..	179	..	87.8
589	439	..	0.75	..	167	..	82.0
550	452	..	0.73	..	156	..	76.2
} 82.0 mean							
Movement of Abduction.							
672	534	..	0.80	..	193	..	94.7
650	518	..	0.80	..	187	..	91.7
621	473	..	0.76	..	177	..	86.8
} 91.1 mean							

These figures give relationships as follows :—

- (1) $\frac{\text{Flexors}}{\text{Abductors}} = \frac{82}{91.1}$ or approx. $\frac{90}{100}$
 (2) Less Basal metabolism $\frac{42}{51}$ or approx. $\frac{82}{100}$

These figures go to prove that movements of muscle groups in common use are performed at a lower cost than work done by groups whose actions in the ordinary course of events, are less often required.

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THE LOAD CARRIED BY THE SOLDIER.¹

By MAJOR N. V. LOTHIAN, M.C.

Royal Army Medical Corps.

Army School of Hygiene.

(Concluded from p. 458.)

XII.—THE NINETEENTH CENTURY ARMIES.

The next great European explosion which sees the nations in arms was the war against Russia 1854-5. By this time the ideas of the European armies on equipment had pretty well crystallized, and accoutrements were being considered from the point of view of their utility rather than as inherited standards; uniforms, however, were still devised more with an eye to effect than to comfort or common sense (e.g., the tight-fitting red serge tunics and showy head-gear) but the innate good sense of the soldiery on service eliminated those more objectionable features which served merely for the parade ground in peace.

The clothing and equipment of the soldier were still stiff and cumbersome and physiologically incorrect, and bore no relation to climate. (Professor Longmore is quoted as asserting that the clothing issued to his unit in Bengal in the Mutiny was heavier than that worn in Canada.) The heavy knapsack which in earlier years had been found to roll on the back like a billet of wood was later steadied by shoulder straps joined by a belt across the chest; still later the oblique cross belt with its sixty rounds of ammunition was added. The resulting accoutrement, impeding free breathing as it did, proved, however, a remedy worse than the original evil. The weight of the British equipment before the Crimean War was 57 pounds or with blanket and three days' rations 68 pounds but after the Crimea is given by Parkes as 62½ pounds for the ordinary infantryman (and 48½ pounds for the rifleman, with 20 rounds only), made up of arms and 60 rounds ammunition, clothing and greatcoat, pack and equipment, blanket, water-bottle and three days' rations (McLean gives the figure 60½ pounds). Rossignol (*Hyg. Publ.*) gives the French load at the same period as 72 pounds (including three days' rations). Belcher, who estimated many of the soldiers to carry even eighty pounds, pointed out that these unfortunate men "consistently with the amazing tenacity of official custom" were really no better off than their predecessors at Bunker Hill almost a century earlier. As Parkes quotes, "no great marches have ever been made by men so loaded," which summarizes effectively the truth as regards the Crimean armies.

The fact is that discipline was now such as to ensure each man bearing his own load, by the elimination of camp followers, women, and

¹ A report to the Army Hygiene Advisory Committee.

most of the auxiliary transport, with the result that that load, acting on the comparatively small regular soldiery of the day, virtually turned him into a mere baggage carrier, and restricted all liberty of movement for fighting. Not merely was there this negative result, however, but a positive as well, in the form of a sick roll of partly disabled men, and this fact, together with Dr. McLean's investigation (already referred to), and a general appreciation of the fact that the accoutrements were far from perfect, led to the appointment of a Royal Commission on the "Influence of the Accoutrements on Health," and to the recommendation of a reduction in weight to forty-seven pounds, by the elimination of many of the "necessaries" (particularly underclothing), of the existing kit.

The recognition of the importance of the British Commission's inquiry, led to a gradual improvement in the weights of European kits during the following years, as also did the study of the Bohemian and Italian campaigns of 1866, which again showed how necessary it is not to overload the infantry soldier, *vide* the description of the great physical contrast between those who carried and those who did not carry packs (article in *Jahrbücher für die Deutsche Armee*, 1910). The Franco-German War was too short to allow of any prolonged critical observations being made, but it is noteworthy that soon afterwards the German Army commenced experimenting to reduce the load, at that time only about fifty-five pounds (Kirchner) while the French load was reduced to sixty pounds. The pack seems to have been little used in that war, as in the German wars of 1866, when the *Times* correspondent reported that "they had been little looked into." The general agreement was that while the war was too short to show that a light kit can be entirely dispensed with, nevertheless it can scarcely be made too light. The extent of loss of man power on the march may be recalled in the case of the Prussian Guards who left the Rhine 30,000 strong on August 3, 1870. They lost 8,000 men at St. Privat and another 1,000 before Paris on September 19, and yet numbered 9,000 men only after that day. Some 12,000 men had thus fallen out in less than seven weeks' marching, unquestionably from fatigue under heavy equipment, a number superior to the losses from actual combat. The Germans, with characteristic assiduity, thereafter carried out a number of scientific tests on the various aspects of marching, some of which have only recently been repeated and checked; and incidentally succeeded in reducing the load (which had now risen to sixty-eight pounds) by about seven pounds (Lavissee, *Sac-au-dos*). Evidence of the growing realization of the importance of the relation of clothing and equipment to climate is now evident in the various colonial expeditions in which our army engaged. In Ashanti, for instance (*Précis of the Ashanti Expedition*, Appendix 6) we find that the soldier only wore helmet, tunic and trousers, boots and canvas gaiters, flannel shirt and socks; that he carried on his own person his own jersey and cap, haversack and water-bottle, belt and seventy rounds; and that the remainder of his kit was carried for him (great-

coat, waterproof, blanket, trousers, shoes, boots and puttees, shirt and socks). This was a definite concession to considerations for the man's health.

In the American Civil War the combatants found that alteration of the equipment laid down in peace was essential, and the good sense of the troops themselves asserted itself in evolving a kit which was really portable and practical. Henderson describes it (*Stonewall Jackson*), as follows: "As their forefathers of the revolution took post in Washington's ranks clad in hunting shirts and leggings, so the Confederate soldiers preferred the garments spun by their own women to those supplied by the State. Grey of all shades was the universal colour. The coatee issued in the early days of the war had already given place to a short waisted and single breasted jacket. The blue kepi held out longer. The soft felt hat which experience soon proved the most serviceable head dress had not yet become universal; but the long boots had gone, and strong brogues with broad soles and low heels had been found more comfortable. *Overcoats were soon discarded.* The men came to the conclusion that the trouble of carrying them on hot days outweighed their comfort when the cold day arrived. Besides they found that life in the open had hardened them to such an extent that changes in temperature were hardly felt" (*Soldier Life in the Army of Northern Virginia*). "*Nor did the knapsack long survive.* It was found to gall the back and shoulders and weary the man before half the march was accomplished. It did not pay to carry around clean clothes while waiting for the time to use them. But the men still clung to their blankets and waterproof sheets, worn in a roll over the left shoulder, *and the indispensable haversack carried their whole kit.* Tents were rarely seen. The army of the valley generally bivouacked in the woods, the men sleeping in pairs, rolled in their blankets and rubber sheets. The cooking arrangements were primitive, a few frying pans and skillets formed the culinary apparatus of a company, and the pans were generally carried with their handles stuck in the rifle barrels. If, as was sometimes the case, three days' rations were served out as a single issue, the men usually cooked and ate them at once, so as to avoid the labour of carrying them!" So equipped, we are not surprised to hear of the remarkable Shenandoah Valley marches which, it will be recalled, covered some 670 miles in forty-eight days, or about fourteen miles per day, and earned for the troops the title "foot-cavalry."

XIII.—TWENTIETH CENTURY ARMIES.

In the South African War our equipment weighed just under sixty pounds (ordnance scale), but as is well known this scale did not represent the true marching weight. Whereas in earlier periods the soldier took steps to ensure assistance in carrying his kit, more rigid discipline rendered this impracticable for the modern soldier; as a result he made use of the alternative means of lightening his load, viz., by discarding some of it.

As has been pointed out, the normal marching equipment of the soldier in South Africa usually comprised his arms and ammunition, water-bottle and haversack, a total of, say twenty-five pounds only. He thus truly became a mobile or light infantryman.

Even so, and while admitting the excellence of many of our marches in South Africa, the following observations by a foreign officer are illuminating (Gen. d. Verme, *An Italian view of the Boer War*, *Journ. R.U.S.I.*, No. 269).

"The exigencies of transport, together with the aversion of the English soldier to carry loads, and his habit, and that of the officers, of making himself comfortable everywhere, had a pernicious effect on Sir Redvers Buller's operations in January" (one recalls here the *Morning Post* correspondent's objection to his "intolerable deal of transport"). "When he tried to relieve Ladysmith . . . Warren's Division, hampered by the cumbrous transport and by the habit of making short marches took six days to cross a ford unopposed by the enemy, and to accomplish marches that should have been done in two . . . In the Orange Free State the great misfortune of the Boers was that the Field Marshal and his Chief of Staff had organized a new system. . . . Having arranged a proper transport independent of the railways . . . they made the infantry march as they had never marched before, not paying much attention to whether the men and officers had their regulation baggage with them every day. By this means they were enabled to pursue and capture Cronje

"Our ideas on the Continent are very different from those of the English as to the length of marches and the privations soldiers must endure at the decisive phase of a campaign. . . ."

As a result of a revision of our equipment, it had by 1907 been reduced to 54½ pounds, but by the time of the Great War, the new and (physiologically) vastly improved web equipment (1908 pattern) was in use, and the field service load as laid down in F. S. Manual (Infantry), had again risen to 59½ pounds. As is well known, that figure was merely a base line from which the load commenced to climb in an ever increasing curve, as the developments of modern war involved the carriage by the soldier of fresh offensive weapons (grenades, etc.), defensive equipment (steel helmet, box respirator), and clothing (fur or leather coat, and additional underclothes). By these additions the load scaled some seventy-four pounds in summer and eighty pounds in winter, quite apart from the heavy increment resulting from absorption of rain, and the clogging of footwear and clothing with mud. As was to be expected, such a load reduced the marching power of good average troops to a figure which appreciably altered the tactics of war, and was the cause of breakdown of many of the less physically fit men. Such weights indeed rendered nugatory the hope of profitably employing the 100 pounds "bantams" as flexible infantry, and actually resulted in their disbandment. The limitation imposed on the tactical handling of our overloaded infantry was

only two well appreciated by our General Staff, whose information as to the marching powers of the troops will some day be available; but who will agree that the limits of forward movement at the battles of Cambrai and Amiens (limits imposed almost solely by physical exhaustion) indicate some $5\frac{1}{2}$ to $7\frac{1}{2}$ miles as the absolute maximum distance which men—kept up even by the extraordinary stimulus of victory—can hope to cover under such loads. Fig. 17 suggests the load of the Infantryman in the Great War, as actually worn.



FIG. 17.—Infantry, 1918.

In the other armies of the world, a development of equipment on more or less parallel lines has proceeded during the early part of the twentieth century. In France the recruits are drafted to different arms according to medical recommendation. These recruits are called up at 20 and incorporated at 21 years of age. It must be remembered that the limited man-power of France has compelled her to utilize men that her more populous rivals could afford to discard. Thus while Germany could reject forty per cent of the annual classes, France could afford to reject twenty-nine per cent only; again, for every one recruit rejected by

France, Russia rejected five. Under such circumstances a high physical standard is impossible and yet the French load has never been by any means light. Their clothing in the pre-war days averaged some fourteen pounds odd, a figure comparable to that of most armies, and the total load to sixty-six pounds (Lemoine, 1911). This was somewhat higher than the sixty-two pounds quoted by Lavissee (*Sac-au-dos*, 1902), and considerably over Lieutenant-Colonel Dunbar Walker's figure of 56½ pounds, but it is worthy of note that the heavier estimate included the tente-abri. The Chasseurs Alpins bore a heavier burden, viz., 70½ pounds. It is not surprising to find that within recent years the French have made great efforts to reduce the field kit. An "Experimental Division" was testing a kit of some forty-eight pounds only (obtained by drastic reduction of personal necessities, and increased use of regimental transport), but the war appears to have supervened before a general agreement on the new equipment was reached.

The figures of the other European countries and Great Powers may be given as follows : Austria 63 pounds (1902) and 61½ pounds (1911) (average height 5 feet 1 inch) ; Belgium 53 pounds (1911) (average height 5 feet 1½ inches) ; Denmark 67 pounds (1911) ; Germany 60 pounds (1902), and 58 pounds (1911) (average height 5 feet 2 inches) ; Italy 58 pounds (1911) (average height 5 feet 1½ inches) ; Japan 53 pounds (1911) ; Norway 56 pounds (1902), and 52 pounds (1911) ; Russia 64 pounds (*Smerdoff. Handbuch*) ; Sweden 58 pounds (1902) and 61 pounds (1911) (average height 5 feet 2½ inches) ; Spain 60 pounds (1911) (average height 5 feet 1 inch) ; U.S.A. 55 pounds (1902), and 63 pounds (1911) (average height 5 feet 3 inches), (Lieutenant-Colonel Dunbar Walker's figure for U.S.A. is only 53 pounds). These figures are compiled from a variety of sources. It should be made clear, however, that the anthropometrical details refer not to recruits or soldiers but to the average stature of each nation as a whole.

It will be seen from the above, and by an examination of the specimen kits in the Museum of the Royal Army Medical College that the majority of nations, having adopted an empirical equipment with little or no originality, have a kit averaging about fifty-eight pounds, a figure to which our own pre-war kit likewise approximated, and a figure, I venture to submit, too high in relation to the stature of the modern soldier to leave him any available energy for combat after the expenditure resulting from the march ; and indeed frequently proving too high even for ordinary marches. It was a notable fact of the recent war that wherever great or continued exertions were required the kit had to be lightened. If this were not done officially, it was done by the individual soldier. Who, for instance, will ever forget, who took part in it, the exertions of the retreat from Mons (at a time before the load had risen above sixty pounds), when both animals and men had to be lightened by official discards, and when many of the men eliminated first the less essential luxuries of their kit, and finally in many cases, almost the complete contents of the pack, especially

the greatcoat? Such action is largely inevitable under such circumstances unless auxiliary transport is available. As regards the latter, one recalls a vivid picture of another series of enforced marches—the Retreat from Serbia in 1915—when the French troops, clearing the country in front of them by a *razzia*, had flocks of donkeys and asses astride of which they transported themselves, or at least their heavier equipment. The British troops in the same ordeal although not involved to the same extent nevertheless did not despise the assistance of the same stout little animals. It is also worth recalling that the march of the Serb Armies on Belgrade after the break up of Bulgaria in the autumn of 1918—one of the very finest marches in history and one to which students will devote attention—was conducted with divisions of light troops—the veterans of six years of war, unencumbered with anything other than absolute essentials, and even out of touch with transport, other than the convoys of light Ford vans which with difficulty followed in their tracks.

We see, therefore, from this short historical review that there has been throughout the ages a conflict between the tendency to load up the soldier, and tactical requirements demanding his mobility. One can almost represent this by a curve of weight, which rises to peaks and again sinks in hollows. The peaks are the eras when equipment has become so cumbersome as to reduce mobility to vanishing point (the point where tactics disappear); and the curve again begins to fall when some wise commander has revolutionized the warfare of his era by introducing light troops, restoring mobility, and so ensuring success. As a result of each such lesson the weight of the soldier in the succeeding period has dropped, only to rise once again in peace. *At the moment we are at the crest of a rise, and drastic reduction is indicated, after the fashion of the wise leaders in past ages, if the infantryman of to-day is to regain that flexibility on which success in the field depends.* Such reduction inevitably involves bold new conceptions as to what is really and only *essential* in the equipment, allowing for the new mode of war, and for existing and future developments in war apparatus and transport. Fig. 18 suggests roughly the graph curve referred to above; I make no claim for it being absolutely accurate or complete.

A study of history has, then, a certain value. It demonstrates for instance the age-long tendency to issue to the soldier in peace an equipment weighing some fifty to sixty pounds, apparently on the assumption that he could *support* it in battle, and would in any case be the better of the items of which it was composed; further, that for the most part soldiers employed auxiliary transport to *carry* this equipment on the march, or where this was not available discarded the excess beyond what they could carry with comfort. But history does not afford exact data on which to base decisions as to what our troops *can* carry. The reasons are obvious; for one thing the mode of war has altered, although the stature of man appears to have changed relatively slightly. More important still

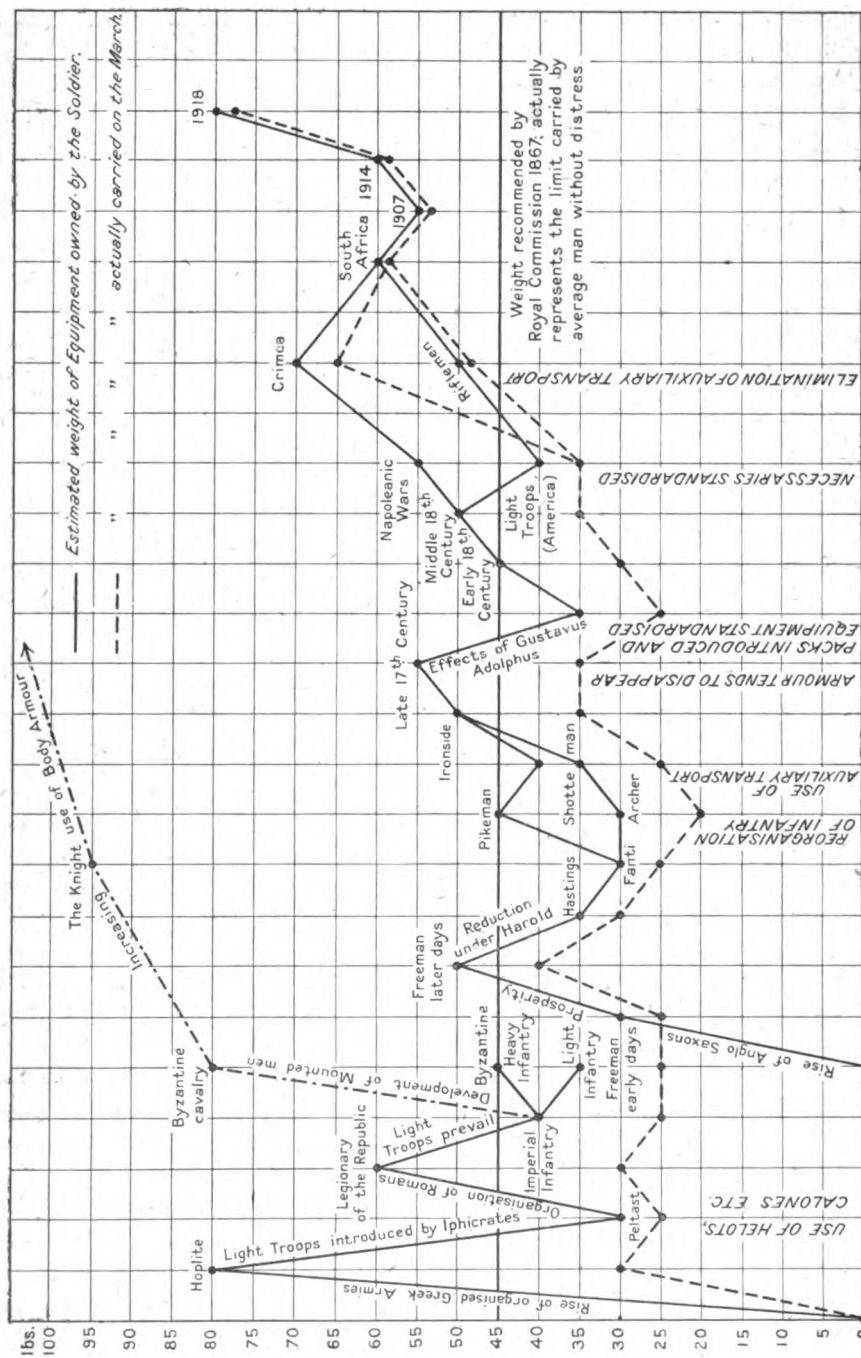


FIG. 18.

is the fact that historical references are fallacious in presenting one side of the picture to us only. Historians have shown us the soldier *in battle* or have described what one might call his "ordnance issue equipment." But as this sketch may perhaps have indicated, such battle descriptions are not necessarily related to the facts of the march, when auxiliary power may be employed to carry part of the load (or even an excess load). This is a natural fault in human psychology, almost more dazzled by the striking facts of dramatic conflict than interested in the prosaic but none the less important facts of administration and interior economy. It is as evident to-day as ever; and already many historians would be hard put to it to give a clear account of the colossal work of "Q" in the recent war; while the late Sir John Cowans, speaking recently at Carlisle, complained with reason that in the thanks given by Parliament to the Army, no mention had been made of the work done by the Administrative Services, although as a whole the war was one of administration rather than strategy or tactics.

XIV.—THE RELATION OF LOAD TO PHYSIQUE.

Obviously the stature and build of troops have a limiting influence on the load which they can carry. Anthropometry being a comparatively young science, a few data only are available in reference to the older armies. We know that the Greeks, especially the Spartans, particularly stressed the training of their troops; as also did the Romans (*vide* earlier section); but their measurements I cannot quote.

The Roman recruits do not appear to have been physically superior to the neighbouring peoples of Italy, but though not gigantic, were well made and, by reason of their frugal life, physically fit and hardy. Few recruiting standards of height are available, but one is referred to by Vegetius as the minimum for the first cohorts of the legions, and for the Guards, namely five feet six inches. This reference illustrates well the ease with which mis-statements are transcribed, it being commonly stated, without qualification, that the Roman soldier was only recruited above five feet ten inches. The fallacy is due, of course, to the fact of overlooking the difference in the Roman and the British inch. Five feet ten inches in Roman units equal five feet six inches in present day units. Such a standard for the Guards does not imply great stature among the soldiery at large.

The infantry of the Middles Ages seem to have been strong burly men of sinew to draw the long bow and wield the pike, able in many cases to employ weapons that the contemporary French did not care to be burdened with, for "we are not strong enough and do not have such personable bodies as you Englishmen" (*Noue, Mil. Franc.*, and letter in *Archæologia* XIII).

In the Napoleonic era, the general employment of fire-arms and their improvements made it generally realized that the physique of the indi-

vidual soldier was not so important as in the days of heavy armour and offensive weapons, and numbers rather than quality became the dominant factor. This is reflected in the physique of the troops, particularly in the case of the French. That latter recognized that "height is more often a matter of country and race than of robusticity" (Boudin), and that medium sized men have usually proportionately greater chest measure, weight and muscle than the taller men. It is of interest to note Larrey's observation that the shorter races of the Midi resisted better than those of the North the tremendous physical ordeal of the retreat from Moscow. Contemporary observers noted that the French were, on the whole below the medium standard of most countries, and inferior in bulk to many, yet they were elastic and active, having the force they possessed at ready command. As a result they moved with ease and freedom and sustained long marches with facility. We may remark the gradual reduction of the French recruiting standards as the continued wars drained the manhood of their country. We find (Proust, *Tr. d'Hyg. Mil.*) that the minimum standards were, in 1776, 5 feet 5 inches; in 1792, 5 feet 4 inches; but in 1813, just under 5 feet.

While formerly the soldier was a sturdy yeoman, the changing social system of the nineteenth century has produced a predominance of urban recruits of less excellent physique. Thus, as regards the stature of the soldiers of the Crimean period, Parkes informs us that the majority of our recruits were of a height below the mean, but taller than the French recruit of the same period. With that true instinct which he showed in so many departments of military hygiene, he laid importance not only on the height but on the weight of recruits, and showed that while the majority fell within 120 and 130 pounds, a fair number ranged between 110 and 140 pounds. Considering the average youth of 18 years of age should be five feet four inches tall and 124 pounds in weight, he advised that no recruit should be accepted, even in the time of greatest pressure, under 18 years of age, 5 feet 2 inches in height, and 112 to 116 pounds in weight. At this time the average Frenchman was 5 feet 1½ inches (and the German 5 feet 3¼ inches); and the French recruiting minimum was 5 feet ½ inch.

When we recall the startling figures as to the nation's physique to-day, as published by the National Service Medical Boards, it is not surprising to find the recruit a youth of none too gladiatorial proportions. In some armies, e.g., the Turkish, the majority are still of peasant origin, and as a result we find an infantry of splendid physique; but most of the more "civilized" nations have to face the same problem as ourselves. It comes down to careful selection and thorough training. In pre-war days the British recruit averaged at 19 years of age some 5 feet 6½ inches in height, and 127¾ pounds in weight. The figures naturally fluctuate with the type of recruit, which is in part a reflex of the industrial state of the country, but over the twenty years before the war averaged similar figures,

viz., almost five feet seven inches and 126½ pounds. Lieutenant-Colonel Sylvester Bradley's figures for 1919 and 1920 recruits show the average to have been on enlistment almost five feet six inches and 122 pounds, i.e., slightly lower than the pre-war figures. The recruit's condition on enlistment does not, however, give a fair indication of his mature physique; being young, he probably grows in the majority of cases, and almost always adds muscle and weight. In our own forces the average increment of weight resulting from twenty weeks' training is some eight pounds, which brings the present-day trained recruit (average) to 130 pounds. I cannot trace any figures for our own army as to the later weight of the soldier, and information on this point is required, as lads of 19 will certainly in most cases continue to add weight for a period after training at a declining rate. In the French army the recruits, called up at 20 and incorporated at 21, are nearer maturity, and the increment is, naturally, not so notable. Dettling (*Le Corps Humain*) states that the average increase in the training period is 5½ pounds, and that the average of older soldiers is nearly three pounds more. If this is so among men of 21, I think one could safely predict an increase of at least five pounds in our own young recruits after training, which would raise the average weight to some 135 pounds.

The French, whose recruits have of late years averaged some 5 feet 4½ inches (Proust, *Traité d'Hyg.*) had for a long time a minimum recruiting standard of 5 feet ½ inch, but an order dated April 14, 1901, laid down that there was to be no minimum (or maximum) of height, except for the Chasseurs-à-pied, standard 5 feet 6 inches. With their usual clarity and prescience, the French laid stress on body weight rather than on physique, and while for a time forty-eight kilogrammes was suggested, an order dated January 18, 1908, defined fifty kilogrammes (110 pounds) as the minimum recruiting weight (Lemoine, *Tr. d'Hyg. Mil.*).

Inasmuch as the load to be borne must bear a definite relationship to the soldier's strength, which is normally a function of his weight, it is evident that more attention requires to be paid to this question of weight than has always been given it in our army. Height and chest at present dominate our recruiting conceptions; it would appear that we ought also to consider weight, either by itself or in conjunction with height. The French have no minimum height except for their Chasseurs, but they wisely insist on a minimum chest measurement and a weight of fifty kilogrammes = 110 pounds. The Chinese recruit men down to 4 feet 8 inches (4 feet 6 inches in the Southern Provinces), but require each man to show that he can lift 133 pounds with his arm extended. If weight alone were not an agreeable criterion for our own forces, certainly a proper relationship between height and weight is essential. Broca's formula, that the weight should (in kilogrammes) be at least as much as the number of centimetres of height over one metre is perhaps somewhat severe; and many would prefer Morache's figures, viz.:—

Height of		Should have a weight of
1.55 m. ..	..	.. over 55 kilogr.
1.60 „ ..	..	.. 58.60 „
1.65 „ ..	..	.. 61.62 „
1.70 „ ..	..	.. 63.64 „

The value, too, of the "sitting height" as a standard is worth considering, representing as it does the real "body" of the man apart from the less important and more variable length of leg bones. This measurement is now widely used in Europe and in anthropometrical work generally.

By training of his physique we finally prepare the soldier to use his arms, withstand hardship, and fit himself for the exigencies of war. But while much of our army training is splendid, history appears to show that we have not concentrated enough on training troops to march under the conditions *and load* of war. The realities of war involve hardship and often enormous increases in exertion—the very conditions that present day civilization tends to make men less able to endure, and that liberal issues of "necessary" underclothes, etc., only augment. The remarks at an earlier stage of this paper as to the wisdom of really hardening troops in peace apply with force here. But it is in regard to marching with a load that our soldiers would probably benefit most by special training. Shortly before the war observations on the marching of the troops called for the following commentary: "With regard to men falling out on the march, officers commanding infantry battalions do not appear, speaking generally, to recognize that there is such a thing as a science of marching, based chiefly on the physiological effect of the work entailed" (*Report on Army Manœuvres*, V., 1910). The need for training our men in marching was constantly stressed by Wellington, as may be seen from his orders and dispatches; yet his troops bore a load less even than that with which our troops took the field in 1914 (Wellington himself estimated the load at four stones—Stanhope, *Notes of Conversation with the Duke of Wellington*). He constantly reiterated that the troops should be trained not only to march, but to march *with a load*. Ranken (*loc. cit.*), admiring the marching power of the French African Troops, comments: "It is a pity the French system cannot be introduced into our own army; for though Tommy Atkins might complain about the pack in peace time, in the field he would become a modern Balaam."

All successful marching armies have insisted on such training in peace, from the Romans (*vide* earlier part of this paper), through Cromwell's armies to the present day. The French Chasseurs' method is for companies to march twice weekly for 12½ kilometres in drill order; later for battalions to march thrice weekly for 18 kilometres in light kit and carrying the blanket; and finally at the end of the training season for the complete regiment to march four times a week a distance of 25 kilometres in complete marching order. The Germans take their recruits out early to learn the use of ground (*cf.* our own recruits' field days), making them

cover at least 10 kilometres in light kit; 1 kilometre is added weekly and a proportion of the equipment, till finally a 12 miles' march in full field kit is achieved without distress. There is much wisdom in this practice and it would appear that we might profitably increase our peace marches with loads, or substitute occasional cross-country marches under field conditions (other than enemy action). Luard, in pre-Crimean days, advocated marching troops from Aldershot to Edinburgh as the soundest "field" training, and there is much wisdom in the suggestion. The growing interest in games is, of course, a valuable adjuvant in improving physique and muscle-tone, and it has wisely been the aim of the directing staff to insist on games wherein every man can take part (cf. the compulsory practice of running games in the Japanese army). The tendency of townsmen to play the part of onlooker rather than of performer has to be combated: and the realization of the importance of games has led to their adoption as a cardinal part of training not only in our own but also in the French army. Recent figures are not available, but older observations of Dettling (1905) showed that a recruit who took four minutes to run 600 metres, was able to cover the same distance after his training in three minutes and five seconds.

XV.—THE STUDY OF THE OPTIMUM OR IDEAL LOAD.

It is obvious to anyone who undertakes it, that marching with a load entails a considerable expenditure of energy. Comparative studies on the effects of different loads can thus be made by observing the results on bodies of individuals; or more theoretical studies can be carried out by calculation, to arrive at the cost of marching a certain distance under a set load. The latter method, however (for example Houghton's formula) does not allow for the effects of fatigue, climate, bad roads, or other extraneous factors, and is less satisfactory than the empirical method.

By observation on their troops, the military students and authors, Thurnwald, Barthélémy and Von Plönnies independently came to the conclusion that for young adults of 20 to 23 years of age, averaging 145 pounds body weight, a load of forty-eight pounds should not be exceeded, i.e., a proportion of thirty-three per cent of the body weight. At the same time efforts to reduce the cumbersome German equipment led to certain tests being carried out in the Institute Frederick William in Germany, these test marches under varying loads ranging as far as fifty miles, and thus giving a fair indication of the truth. (For details, *vide* Keim, *Équipement de l'Infanterie*, and *Militär Zeitung*, 1895.) It was found that over a standard fifteen miles stretch, a load of forty-eight pounds could be taken by the subjects (well nourished robust men) without resultant harm in cold weather, but in warm weather this load caused a temporary disturbance, which however cleared off by the following day without leaving ill effects. With a load of sixty pounds, distress was felt whenever the weather was at all mild, and on such occasions did not always

disappear by the day following. With a load of sixty-nine pounds even when the weather was cool and the march carried out at a medium rate, there was considerable distress; and no amount of practice could avoid this. If then, forty-eight pounds (about thirty-three per cent of body weight) sufficed to produce even a temporary upset in times of peace it appeared to the investigators to be obviously a decided maximum in the stress and fatigue of war, and the tests thus showed that in fixing one-third of the body weight as the maximum load, the German Major Von Plönnies found himself in complete accord with the findings of hygienists. Of the latter, the most work on the question had till recently been done by Zuntz and Schumberg (*Phys. d. Mar.*) whose findings have long stood accepted and unchallenged. These very careful workers also found that the desirable or optimum load is that which is one-third of the body weight, and that the effective maximum is forty-five per cent of it. Above this, the cost of carrying the load rises disproportionately to the actual increment of weight—in other words it is an uneconomic proposition. And yet our infantry have usually carried a load well above that figure: it is no wonder the phrase “loaded like a mule” is applied although even that simile does not do justice to the case. An 1,100-pound mule for instance rarely carries over 350 pounds load (the Indian Army transport mule takes 160 pounds only), the latter therefore hardly ever reaches thirty-three per cent of the body weight: and the cavalry horse takes up to twenty-eight per cent of its weight only. The pity is that the infantry man, shaped so little like a beast of burden, is loaded much more heavily than any of them, and that the limits which we forbear to exceed in the case of animals should be grossly exceeded in the case of the troops.

The findings of these early workers, however, demand revision by more modern and accurate methods before a definite conclusion is reached; and, fortunately, to-day we have the means for so checking their findings by indirect calorimetry. By this method, which can be carried out under actual field conditions, we can arrive at the exact cost to the man of any special work under conditions simulating those of war, and can compare the effect of different modes of work on his economy. Cathcart and Orr in their valuable study *The Energy Expenditure of the Recruit in Training*, have already applied it to many of the operations of the soldier, and have shown, for instance, that route marching is the soldier's costliest effort, and takes more out of him than twice the cost of even bayonet exercise. The method is applicable, and eminently suitable, for determining definitely the optimum load of the soldier, but will involve a long series of observations before results can be published which may be accepted as final. Meanwhile there is obviously sufficient room for reduction in the weight of the equipment without waiting the precise relation to be fixed between load and body weight. When a revised and lighter equipment is adopted—as ultimately, it would appear, it must be—such a standard relationship would inevitably give weight to the argument in favour of fixing a definite minimum recruiting weight allowing for the growth increment: and

obviously will have an important bearing on many other aspects of the military machine. It is no part of the writer's task, however, to advert to the future, but only in the present paper to discover what are the lessons of history *in re* load.

XVI.—CONCLUSIONS.

In general, it would appear :—

(i) That equipment-loads in the past have borne little relation to the actual carriage of the equipment on the march, and that assistance has usually been available for the latter.

(ii) That the perfected and disciplined organization of our army to-day relies on the carriage by the individual soldier of his own equipment, although that is not only as heavy as but actually heavier than it has practically ever been before : the result being a marked diminution of mobility.

(iii) That the problem to-day is so to reduce the equipment of the fighting man as to restore his mobility. Never was mobility more important than to-day when the conditions of war demand exertions from the infantryman to which no former campaigns are comparable, and when the terrain of war itself makes mobility more than ever a difficulty. It has been observed that the final stages of Waterloo were not much longer than those of Crecy or Agincourt ; very different is the battle of to-day, however, when the final stages may continue for days, involving constant rushes, advances or retirements and a total of marching which was relatively absent in the more static shock battles of the past. In such circumstances the value of tactical mobility is overwhelming. This fact was clearly realized by von Moltke. Anent the observation of a member of his staff that a battalion of real light infantry appeared necessary, he minuted the following commentary : " From the standpoint of strategy what we want is not a light Battalion but a light Army . . . a tactical victory can only be obtained by an Army equally mobile in all respects . . . Such mobility is only to be obtained when the Army is formed of sturdy men, well practised in peace, well fed in the field, and carrying as regards all arms a really practical equipment. An Army which marches light will also manœuvre freely. *Everyone agrees that our equipment must be lightened, but when it comes to the point and one has to decide what articles have to be dispensed with, there is endless variety of opinion.*" " Aye, there's the rub," and there is the problem confronting us now.

Note.—The writer has laid toll, for the data of this memo, on the many splendid historical and regimental records in the British Museum, the War Office Library, and elsewhere ; and has had suggestive criticisms from more kind friends—military, professional and lay—than he can well enumerate here. It is hoped that references inadvertently overlooked in the text will be forgiven. I am specially grateful to Mr. (late Staff-Serjt.) F. G. Grierson, M.S.A., for his careful work in adapting and reconstructing

the illustrations (Nos. 1, 2, 4 to 16) from various sources, and to Captain J. Inglis, O.B.E., R.A.M.C., for figs. 3 and 17.¹

ADDENDUM.

Interesting data as to the German armies in the Great War are to be found in Price's "*Boche and Bolshevik*." He notes that the training included "all kinds of gymnastics," and that "all our marching was made to assimilate as near as possible to war conditions, our knapsacks were filled with sand, and the weight of our equipment was about what we had to bear in the field (75 lb.)." Further, "The German soldier was trained in time of peace to be good at marching Long forced marches under the conditions of actual war were frequent." "The Russian Campaigns" (especially, he notes, the battles of the Masurian Lakes) "were won by bluff and *good marching*."

The author's opinion of the German equipment may however be estimated by a perusal of his criticisms, while the effect of the load carried is admitted, e.g., "The strain of these exercises was severe." "It was found when we arrived at the Front that most of us had thrown the extra boots away rather than be bothered by their extra weight," etc. As to the effects on the troops on service on the Western Front—"The soldiers had to press forward by forced marches, and in order to lighten their steps they threw away everything they could spare—knapsacks, bread-bags, mantles, and trench-tools. Some even got rid of their tunics and marched in their shirt-sleeves. For miles the roads were lined with the cast-off effects of the German soldiers. Many men could not keep up and fell fainting or dying by the way-side."

¹ This Report was compiled for the Army Hygiene Advisory Committee by Major N. V. Lothian.

MALARIA IN MACEDONIA, 1915-1919.

PART II.

CLINICAL OBSERVATIONS ON THE TREATMENT OF
MALARIA IN MACEDONIA.

By A. GREIG ANDERSON.

Temp. Major, Royal Army Medical Corps.

In the treatment of malaria there are two distinct ends in view, first, the control of the actual febrile paroxysm, and second, the prevention of relapse. It is with the second of these objects that the present report deals.

In estimating the results of any method of treatment it is essential to have evidence on certain points: (1) The number of cases treated; (2) the type of infection present; (3) the result of blood examination after treatment; (4) the duration of observation after treatment.

In all cases admitted to the special wards, a positive blood film had been obtained. The majority of cases were admitted from other hospitals, but all had with them a record of one recent positive blood film.

Practically all were benign tertian infections with frequent relapses. When this is not so it is stated under the description of the particular form of treatment used.

Treatment in the majority of cases was commenced during an apyrexia interval. The examination of daily blood films in all cases under treatment was not practicable. At first weekly examinations were carried out in all cases, but these yielded such a high percentage of negative results that the method was abandoned. Finally, it was decided to examine the blood films of every case in which the temperature rose to 100° F. or over. After the conclusion of any method of treatment no further quinine was given. If the temperature rose a blood film was taken and treatment postponed until the result of the blood film was known. The criterion of relapse is therefore a rise of temperature to 100° F. or over, with a positive blood film result. A rise of temperature without positive blood film is disregarded in estimating the effects of treatment.

Temperatures were recorded four times a day: at 7 a.m., 11 a.m., 3 p.m., and 7 p.m. All temperatures were taken in the mouth for not less than ten minutes.

An attempt was made to retain all non-relapse cases in hospital for a period of 100 days, giving an observation period of not less than seven to eight weeks. Under the different methods of treatment the shortest and longest periods of observation are stated in all non-relapse cases. In

every case where quinine was administered orally it was given as the hydrochloride of quinine. Where the intramuscular route was employed, bihydrochloride of quinine was dissolved in 0.75 per cent sterile sodium chloride solution and autoclaved for one hour. All intramuscular injections were given in the buttocks.

The following classification gives a review of the different methods of treatment employed, and the results of the various methods will be dealt with in this order.

I.—Control group of cases.

II.—Quinine administration.

(A) Continuous dosage:—

(1) Long sterilizing courses.

(a) C17 recommended by Colonel Sir Ronald Ross.

(b) Oral course for one month. { (i) forty-five grains per day.
(ii) twenty grains per day.

(2) Short sterilizing courses.

(a) Intensive oral course.

(b) Intensive intramuscular course.

(B) Interrupted dosage:—

Quinine on two successive days weekly for a period of eight weeks.

(i) Twenty-grain series.

(ii) Thirty-grain series.

(iii) Forty-five-grain series.

III.—Combination of quinine and arsenic.

(A) Quinine and galyol.

(i) Intensive oral course plus galyol.

(ii) Intensive intramuscular course plus galyol.

(B) Quinine and cacodylate of soda.

(i) Ravaut's treatment.

(ii) Intensive oral course and cacodylate.

IV.—Provocative drugs.

(1) Liquor strychnine injections.

(2) Liquor adrenalin injections.

(3) Liquid extract of ergot by mouth.

SECTION I.—CONTROL GROUP OF CASES.

In the control group one wished to find what happened to cases treated only during an acute attack, and to whom after the attack was over no further quinine was given. Forty-four such cases were admitted to the control ward—all were cases of relapsing benign tertian infection. All were placed on a simple iron tonic mixture. In the event of a relapse the patient was put upon oral quinine in doses varying from thirty to sixty grains per day according to the necessities of the case, and the administration of quinine was continued until the temperature had been

normal for twenty-four hours. The quinine was then stopped and the iron tonic mixture resumed. Of the forty-four cases fourteen showed no relapse during the period of observation. The observation periods in these cases were : 31, 100, 63, 108, 93, 99, 83, 83, 82, 88, 96, 78, 100, and 83 days. All gave histories of frequent previous attacks. (One of these cases, though not showing a positive relapse, ran a constant subfebrile temperature varying from 99° to 100° F., and was evacuated by hospital ship.) The remaining thirty cases all showed relapses varying in number from one to six according to the length of the observation period. Many of these cases showed an almost exact periodicity in their relapsing times, the most common period was twenty days.

Four cases are quoted in illustration of this :—

M.6012—Four relapses; relapse intervals, twenty-one, eighteen, and twenty-three days.

M.6018—Four relapses; relapse intervals, seventeen, twenty-two, and twenty-two days.

M.6004—Three relapses; relapse intervals, twenty-one and eighteen days.

M.6005—Four relapses; relapse intervals, eighteen, twenty-two, and eighteen days.

In this connexion it should be noted in the detailed analysis of the relapses occurring after treatment that the majority of the relapses occur within a period of from three to four weeks after treatment. This periodicity is most manifest during the hot season. It is obvious that the patients who show this periodicity are not likely to be effective soldiers at least throughout the hot weather, and unless disposed of otherwise, will pass the hot season between the hospital and the convalescent camp. In view of this it would appear reasonable that cases of malaria should be retained in hospital for at least three weeks after the temperature has become normal. In connexion with such cases the results of the Liverpool School of Tropical Medicine are of importance. They state that "if a case of simple tertian malaria has not relapsed parasitically within four weeks of cessation of treatment, he can be discharged from hospital with a risk of relapse of only about thirteen per cent." The risk of relapse in Macedonia is somewhat greater than these figures would indicate, but their results, obtained under more favourable circumstances, are an additional support for the argument that malarial patients should be retained for at least three weeks in hospital after the acute attack is over.

SECTION II.—QUININE ADMINISTRATION.

(A) Continuous dosage.

(1) Long sterilizing courses.

(a) C17 recommended by Colonel Sir Ronald Ross.

In the interim report on the treatment of malaria presented to the War Office by Colonel Sir Ronald Ross, K.C.B., and in a later more

detailed memorandum, this form of treatment is recommended as being "apparently the best treatment for old cases of malaria which has yet been used." The directions for treatment are as follows: "The patient is put to bed for twelve days and given daily for all this period, namely, fifteen grains of the bihydrochloride of quinine intramuscularly in each deltoid muscle, together with ten grains of hydrochloride of quinine in *mistura anticachexia* No. 1 thrice daily, totalling sixty grains of quinine daily for the twelve days. After this the patient is allowed up and is given *mistura anticachexia* No. 2 four times a day; this is sixty grains of quinine daily by the mouth, this treatment being continued for three days. After this the patient is given *mistura anticachexia* No. 3 four times daily for fourteen days; this is twenty grains of quinine daily, the patient being allowed to do light work all this time."

"The total number of cases treated was forty-nine."

"These were treated from July 10, 1917, to October, 1917. Of these cases only five, i.e., ten per cent., relapsed up to December, 1917. The observation period after treatment varied from sixteen to seventy-two days."

This treatment was carried out in the wards according to the above directions. The treatment differed from the original only in one minor detail, viz., that the intramuscular injections were given in the buttocks instead of into the deltoid muscles.

The total number of cases which completed the course, and were observed for a sufficiently long period subsequent to treatment, was forty-four. All were cases of relapsing benign tertian infections.

Of this number, twenty-six cases (fifty-nine per cent) relapsed with positive blood films and fever; eighteen cases (forty-one per cent) did not relapse during the observation period.

Of the twenty-six cases which relapsed, the shortest interval after treatment in which a positive relapse was obtained was sixteen days, the longest interval was sixty-six days.

The following table shows the numbers of cases relapsing in each seven-day period after treatment.

Days :	1-7	14-21	22-28	29-35	36-42	43-49	50-56	57-63	64-70	71-77
	..	1	5	8	7	1	3	..	1	..

Of those cases which did not relapse the observation period after treatment varied from fifty-two days to 111 days.

According to the memorandum, "the treatment was well borne by the patients except for the deafness and tinnitus, and there was very little vomiting." In a later communication dated April 15, Colonel Ross states that the treatment is by no means always well borne.

This latter statement is in accordance with our experience. It is difficult in many cases to persuade the patients to complete the treatment. Of the total cases 93.7 per cent complained of loss of appetite, 81 per cent of nausea, 54 per cent of vomiting, 80 per cent of headache, 91 per cent of

tinnitus, 87 per cent of deafness. The loss of appetite varied from a slight loss at the beginning of the course to a condition where only the lightest food could be taken during the latter half of the intramuscular course. Vomiting continued in two cases from one to twelve days, and in three cases from one to seven days.

All cases at the conclusion of treatment showed well defined induration of the buttocks, varying in degree from a few small shotty nodules to large indurated masses the size of a hen's egg. In every case this induration disappeared entirely within three or four weeks.

Four cases complained of blurred vision during the course. No diminution of the fields of vision was found by rough testing in any of twenty four cases examined.

The high percentage of relapses occurring here is in striking contrast with the high percentage of non-relapses obtained amongst the cases treated in England. The reason for this variation is discussed later on.

(b) Oral course for one month.

(i) Forty-five grains quinine hydrochloride per day.

(ii) Twenty grains quinine hydrochloride per day.

Two series of cases were treated, one in which the patients received daily for thirty days three fifteen-grain doses of quinine hydrochloride, the other in which the patients received daily for thirty days, two ten-grain doses. At the conclusion of the quinine treatment all patients were placed on a simple iron tonic mixture.

Results of Treatment.

	45-grain series		20-grain series	
Total number who completed treatment and a sufficient observation period	18	..	..	16
Number who relapsed	8 (44.4 per cent)	..	10 (62.5 per cent)	..
Number who did not relapse.. ..	10 (55.6 " ")	..	6 (37.5 " ")	..

In the forty-five-grain series, the shortest interval after conclusion of treatment at which relapse occurred was fifteen days, and the longest forty-two days. In the twenty-grain series, the shortest interval was seven days, the longest forty-six days.

The following table shows the total numbers of cases in each series relapsing in each seven-day period after treatment.

Days:	1-7	8-14	15-21	22-28	29-35	36-42	43-49	50-56	57-63
45 grains	..	..	5	2	..	1	..	..	..
20 " "	1	2	3	2	1	..	1	..	..

Of those cases which did not relapse the shortest observation period was fifty days, the longest 120 days.

All the cases in this series were relapsing benign tertian malaria.

As both series were treated at the same time, the results are strictly comparable. Of the two methods the forty-five-grain method is more effective in preventing relapse. In no case had treatment to be abandoned owing to intolerance of quinine.

(2) Short sterilizing courses.

(a) Intensive oral course.

During the first four days the patient is kept in bed, and is given on each day three twenty-grain doses of quinine hydrochloride. An interval of ten days is allowed to elapse, the patient is put to bed and the course repeated. The total amount of quinine administered is 480 grains.

Results of Treatment.

Total number who completed treatment and observation	..	49
Number who relapsed ..	..	15 (31·6 per cent)
Number who did not relapse ..	..	34 (69·4 „)

In this series the shortest relapse interval was three days, the longest eighty-two days.

The following table gives the numbers of cases relapsing in each seven-day period after treatment :—

Days:	1—7	8—14	15—21	22—28	29—35	36—42	43—49	50—56	57—63	64—70	71—77	78—84
	1	2	3	3	1	1	..	1	1	..	1	1

In the non-relapse cases the shortest observation period after treatment was sixty-nine days, the longest ninety-five days.

Of the 49 cases 47 were benign tertian infections and 2 malignant tertian infections; of the 47 benign tertian infections, 43 were relapsing cases and 4 cases gave histories of having had only one previous attack.

(b) Intensive intramuscular course.

During this treatment the patient is kept in bed during the first four days. On each of these days two intramuscular injections of quinine bihydrochloride are given, and in addition twenty grains of quinine hydrochloride in mixture, by mouth. All injections are made in the gluteal region. The patient is allowed up and after an interval of ten days the course is repeated. After the second course the patient was put upon an iron tonic mixture.

Results of Treatment.

Total number who completed treatment and observation	..	58
Number who relapsed ..	..	23 (39·6 per cent)
Number who did not relapse ..	..	35 (60·4 „)

Of the twenty-three relapse cases the shortest interval after conclusion of treatment was ten days and the longest sixty-eight days.

The following table gives the numbers of cases relapsing in each seven-day period after treatment :—

Days	1—7	8—14	15—21	22—28	29—35	36—42	43—49	50—56	57—63	64—70
	..	1	6	6	3	2	1	1	..	3

Of the non-relapse cases the shortest period of observation after treatment was seventy-two days, the longest period was 116 days.

Of the 58 cases treated, 55 were cases of relapsing benign tertian infections and 3 were malignant tertian infections.

In practically all these cases treatment was commenced during an

apyrexia interval. Forty-eight cases showed a febrile reaction, either during or immediately after the intramuscular course. A rise of temperature to 100° F. or over was regarded as a febrile reaction. Thirty-seven cases showed such reaction during both courses, eleven cases showed the reaction during one or other of the courses. This reaction has already been pointed out by Major Gunson, R.A.M.C., and it is not accompanied by any rigor.

A large number of cases showing this reaction have been examined by daily blood films. In no case has a positive blood film been found. Two temperature charts are shown as examples of this, one a mild and one a moderate reaction.

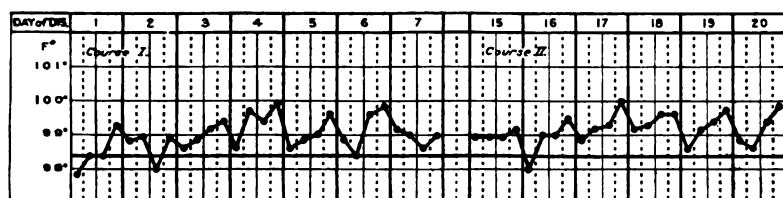


CHART I.—Type of mild reaction occurring during intramuscular course and persisting for two days after: temperature not above 100° F.

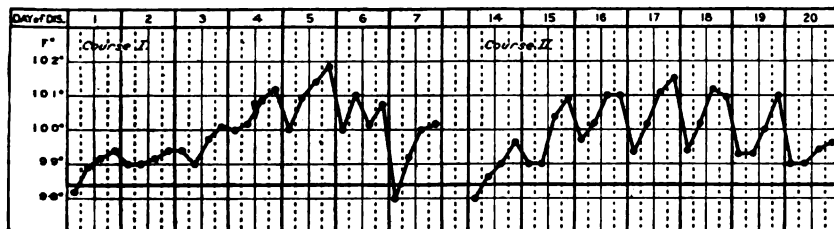


CHART II.—Type of moderate reaction occurring during intramuscular course and persisting four or five days.

It was thought that the reaction might possibly depend on the method of preparation of the quinine for intramuscular injections and a certain number of cases were therefore treated with ampoules of quinine prepared by Parke, Davis & Co. The results were precisely similar.

It has also been suggested that the fever is caused by the destruction of malarial parasites elsewhere in the body than in the peripheral circulation and caused by toxins thus liberated. If this were so, a similar pyretic effect of quinine should be observed in cases treated by the double intensive oral course. In forty-nine cases treated by the double intensive oral course no such reaction has been observed.

The naked-eye examination of the site of the intramuscular injection post mortem presents a striking appearance. Over a wide area depending

on the number of injections given, the muscular tissue is black or greenish-black in colour. Histological examination shows large areas of necrosis of the muscular bundles. The febrile reaction is also accompanied by a rise in the total leucocyte count varying in several cases from twenty-four to twenty-seven thousand per cubic millimetre. From the morbid anatomy of the muscle and the rise in the total leucocyte count we believe that the febrile reaction is a response to the local destructive action of the quinine on the muscular substance.

In the treatment of these cases some 960 injections have been given. Abscess has occurred in one case.

(B) Interrupted dosage (week-end series).

In a series of cases quinine was administered on two successive days of each week for a period of not less than eight weeks. Three groups were made according to the amount of quinine given.

Group (i) received 20 grains of quinine on two successive days, the patient receiving on each day two 10-grain doses of quinine hydrochloride; Group (ii) received 30 grains in three 10-grain doses on each day; Group (iii) received 45 grains in three 15-grain doses on each day.

Results of Treatment.

The twenty-grain series have not completed a sufficiently long observation period to be included. In the thirty-grain series two cases relapsed during treatment, one of these relapsed after the first two-days' treatment. Treatment in this case was carried on to the full eight weeks and no further relapse took place up to fifty-nine days after the last dose of quinine. The second case relapsed after six week-end doses had been given and was not further observed. In the forty-five-grain series no case relapsed during treatment.

	30-grain series	45-grain series
Total number who completed treatment and a sufficient observation period	57	21
Number who relapsed	11 (19.3 per cent) ..	8 (38.1 per cent)
Number who did not relapse	46 (80.7 ..) ..	13 (61.9 ..)

In the thirty-grain series, in the relapse cases the shortest interval was six days, the longest forty-five; in the forty-five-grain series the shortest interval was one day, the longest thirty-three.

The following table gives the relapses in each seven-day period after treatment:—

Days:	1—7	8—14	15—21	22—28	29—35	36—42	43—49	50—56
30 grains	1	..	4	2	3	..	1	..
45 ..	1	3	1	2	1	..	..	..

In the thirty-grain series, of the cases which did not relapse the shortest observation period after treatment was twenty-four days, the longest fifty-nine; in the forty-five-grain series the shortest was thirty-nine days, the longest forty-six.

In both series all cases were benign tertian relapsing infections.

It will be noted that in the week-end series the observation periods are somewhat shorter than in some of the other series. An endeavour was made to retain all non-relapse cases in hospital up to the hundredth day, but even so the period of observation after treatment amounts only to forty-four days.

The interrupted administration of quinine is much better tolerated than the continuous administration.

SECTION III.—COMBINATION OF QUININE AND ARSENIC.

(A) Quinine and galyl.

(i) Intensive oral course plus galyl.

(ii) Intensive intramuscular course plus galyl.

A considerable body of literature has been published on the newer arsenical preparations in the treatment of malaria. The consensus of opinion is favourable in the acute pernicious and in the chronic relapsing cases. A certain amount of experience had already been gained in the use of galyl in both types of cases. The most hopeful method appeared to be the combination of intensive quinine either by the oral or intramuscular route combined with a full course of galyl.

(i) *Oral Quinine and Galyl*.—The double intensive oral course of quinine is carried out as already described. In addition, five intravenous injections of galyl, dose forty centigrammes, are given at intervals of one week. An initial dose of twenty centigrammes is given followed by five full doses of forty centigrammes. The full course amounted to 480 grains of quinine hydrochloride and 2.2 grammes of galyl.

Owing to the shortage of galyl in the command the full course could not be carried out in every case. The number of cases is therefore divided into groups according to the total quantity of galyl administered.

Results of Treatment.

Total number who were treated with quinine and galyl and who completed a sufficient observation period	..	..	39
Number of relapses	..	..	22 (56.4 per cent)
Number who did not relapse	..	..	17 (43.6 „)

Of the 39 cases, 26 received the full galyl course of 2.2 grammes, 12 received 1.4 grammes galyl, and 2 received 0.6 gramme galyl.

No case relapsed during the first six weeks of treatment, i.e., while the weekly doses of galyl were being given.

The shortest interval in which a relapse took place after the last dose of galyl was ten days; the longest interval was fifty-four days.

The following table shows the number of cases relapsing in each seven-day period after the conclusion of treatment, i.e., calculated from the date of the last dose of galyl.

Days: 1—7	8—14	15—21	22—27	28—35	36—42	43—49	50—56
..	8	9	4	..	..	..	1

In the cases which did not relapse the observation period varied from forty-four to ninety-two days after treatment.

All cases treated in this series were cases of benign tertian infections.

(ii) *Intramuscular Quinine and Galyl*.—This method is similar to the oral quinine and galyl except that of the three twenty-grain doses of quinine given daily, two are given by the intramuscular route and one by mouth.

Results of Treatment.

Total number treated by intramuscular quinine and galyl and who completed a sufficient observation period	..	..	58
Number who relapsed	..	..	28 (48·2 per cent)
Number who did not relapse	..	..	30 (51·7 „)

These are further subdivided into groups according to the total amount of galyl received.

(i) Those who received 2·2 grammes galyl : Total number, 24 —	
Number who relapsed	.. 15 (62 per cent)
Number who did not relapse	.. 9 (38 „)
(ii) Those who received 1·8 grammes galyl : Total number, 7—	
Number who relapsed	.. 3 (42·8 „)
Number who did not relapse	.. 4 (57·2 „)
(iii) Those who received 1 gramme galyl : Total number, 5—	
Number who relapsed	.. 3 (60 „)
Number who did not relapse	.. 2 (40 „)
(iv) Those who received 0·6 gramme galyl : Total number, 22—	
Number who relapsed	.. 7 (31·8 „)
Number who did not relapse	.. 15 (68·2 „)

One case relapsed during treatment. He relapsed six days after the conclusion of the first intramuscular course and one day after second dose of galyl. The shortest period in which a relapse took place after the conclusion of treatment was twelve days, the longest forty-nine.

The following table shows the total number of cases relapsing in each seven-day period after the conclusion of treatment. The case which relapsed during the treatment is not shown on this table.

Days: 1—7	8—14	15—21	22—28	29—35	36—42	43—49	50—56
..	16	5	5	1	..	..	..

In the non-relapse cases the shortest observation period was thirty-eight days, the longest seventy-eight days.

All cases in this series were benign tertian infections.

In all cases the galyl was given intravenously in concentrated solution. On the day previous to injection the patient was kept in bed, given milk diet and a laxative. One case only was intolerant and treatment was abandoned.

A comparison of the two methods is slightly in favour of the combined intramuscular quinine and galyl, but the difference is negligible.

In the intramuscular series some 1,000 injections were given, and in no case did abscess result.

(B) Quinine and cacodylate of soda.

(i) Ravaut's treatment.

Ravaut recommends that the patient should be given a daily hypodermic injection of 0.20 gramme cacodylate of soda for four days. During the next four days the patient is given daily two fifteen-grain doses of quinine hydrochloride by mouth. The cacodylate and quinine are given alternately for thirty-two days irrespective of relapse. This method has at least the merit of simplicity. The total amount of quinine administered during the thirty-two days' treatment is 480 grains, and the total amount of cacodylate of soda 3.2 grammes.

Results of Treatment.

Forty-four cases completed treatment and were observed for a sufficiently long period. Four cases relapsed during treatment. One relapsed on the tenth and twenty-ninth days of treatment, and was not further observed. Another relapsed on the second day of treatment, and again six days after conclusion of treatment. The third relapsed twice during treatment on fourteenth and twenty-fourth days, and again three days after the conclusion of treatment, and the fourth relapsed on the fifth day. He completed treatment and did not relapse again within a period of forty days.

Total number of cases who completed treatment and a sufficient

observation period	..	..	..	..	..	43
Number who relapsed	..	..	..	..	..	22 (51 per cent)
Number who did not relapse	..	..	..	..	..	21 (49 " ")

Of the relapse cases the shortest interval after the conclusion of treatment was three days, the longest fifty-three days.

The following table gives the total number of relapses in each seven-day period after treatment.

The first case which relapsed during treatment is not shown on this table.

Days:	1-7	8-14	15-21	22-28	29-35	36-42	43-49	50-56	57-63	64-70
	4	2	5	6	1	3	..	1	..	..

Of the non-relapse cases the shortest observation period was fifty-two days, the longest 108 days. All were cases of benign tertian infections. The treatment was well borne.

(ii) Intensive oral course and cacodylate of soda.

The intensive oral course was carried out as already described.

In addition, on three days of each week the patient was injected hypodermically with three grains of cacodylate of soda. The cacodylate injections were given for five weeks.

Total quantity of quinine given, 480 grains; total cacodylate of soda given, 45 grains.

Results of Treatment.

Total number who completed treatment and observation	..	25
Number who relapsed	..	8 (32 per cent)
Number who did not relapse	..	17 (68 " ")

Of the eight cases which relapsed, two did so during treatment—i.e., within the first five weeks; six relapsed after treatment. The shortest

relapse interval calculated from the last dose of quinine was thirteen days, the longest forty-four days.

Of the cases which did not relapse the shortest observation period was seventy-five days, the longest was 108 days. All were cases of benign tertian infection; two cases gave a history of having had only one attack of malaria previous to treatment.

SECTION IV.—PROVOCATIVE DRUGS.

- (1) Hypodermic injections of strychnine sulphate.
- (2) Hypodermic injections of adrenalin chloride.
- (3) Liquid extract of ergot by mouth.

In all cases blood films were examined on the day before the drug was given and on the two subsequent days.

- (1) Strychnine sulphate.

Eight cases were given hypodermic injections of this drug; dose $\frac{1}{16}$ grain at intervals of six to nine days. Seven of the cases had five injections and one three injections.

- (2) Adrenalin chloride.

Four cases were given hypodermically ten-minim doses of adrenalin chloride solution (1 in 1,000) at nine day intervals, in all five injections each. Four cases were given twenty-minim doses, in all five injections each.

- (3) Liquid extract of ergot.

Nine cases were given thirty-minim doses by mouth at intervals of nine days—five doses in all to each patient.

All cases tested were chronic relapsing benign tertian infections. While these drugs were being given, quinine was withheld save to control a relapse.

Amongst the whole series only nine positive relapses took place, and these at varying intervals after the dose. No patient had two positive relapses.

From the small number of relapses which occurred from the irregularity of the time intervening between a dose and the relapse, and from the fact that no patient had two relapses, it is evident that none of these drugs have any effect.

The table on next page shows the total number of cases treated by all methods, the number of relapses, the number of non-relapses and the percentage of each. The figures in this table include relapses under treatment.

As these results stand it would appear that the two methods most effective in preventing relapses are the thirty grains on two successive days in each week, and the intensive oral course. It was noted, however, in the analysis of the figures of the cases treated by intramuscular quinine and galyl that as the quantity of galyl diminished, the quinine dosage remaining constant, the percentage of non-relapse cases increased. Again,

in the intramuscular series it was not unusual to find in the cases treated in the later part of the year a dozen or more consecutive admissions which did not show any relapse.

Treatment	Number of cases	Relapses	Non-relapses	Percentage relapses	Percentage non-relapses	Remarks
C17 Ross treatment ..	44	26	18	59.0	41.0	—
Oral course, 45 grains ..	18	8	10	44.4	55.6	—
Oral course, 20 „ ..	16	10	6	62.5	37.5	—
Intensive oral course ..	49	15	34	30.6	69.4	—
Intensive intramuscular course	58	23	35	39.6	60.4	—
Week-end, 45 grains ..	21	8	13	38.1	61.9	—
Week-end, 30 „ ..	58	13	45	22.4	77.6	Two relapsed during treatment, one after first week-end, one after six week-ends
Intensive oral and galyl..	39	22	17	56.4	43.6	—
Intensive intramuscular and galyl	58	28	30	48.2	51.8	One relapsed during treatment
Ravaut	44	24	20	54.5	45.5	Four relapsed during treatment; one of them was not further observed
Oral course and cacodylate	25	8	17	32.0	68.0	Two relapsed during treatment
Control series	44	30	14	68.1	31.8	—
Injection series	25	..	..	..	..	—
Miscellaneous	1	..	..	..	..	—
Total	500	..	..	..	..	—

It is of interest to discuss solely the intramuscular series of cases. The dosage of quinine and the method of its administration remained constant throughout the whole period under review. There was no reason to suppose that there had been any variation in the potency of the quinine itself, all the quinine had been supplied by the same makers throughout. The type of case did not vary materially. Of the fifty-eight cases treated, fifty-five were cases of relapsing benign tertian infection, and three were cases of malignant tertian infection. The three malignant cases occurred in the later group of cases, but the numbers are too small to make any appreciable difference in the results. The period of observation after treatment remained the same. The possibility that the disappointing results could be attributed to more numerous reinfections can be dismissed as all cases were protected by nets, and the area in which the hospital was situated was known to be practically free from anopheline mosquitoes.

The only other explanation which suggested itself was that the results depended on the season of the year at which treatment was carried out.

In view of the possibility of a seasonal variation, a second analysis of the figures was made. The first batch of patients was admitted towards the end

of April; these remained till middle of July, when a fresh batch of patients was admitted to the wards. The cases were therefore divided into two groups, the first group including those who were admitted and completed treatment before July 1, and the second group those admitted and treated after July 1.

The following table shows the results in the two groups of cases.

GROUP I.—Admitted and treated before July 1						GROUP II.—Admitted and treated after July 1				
Type of treatment	Number of cases	Re-lapses	Non-re-lapses	Per-centage relapses	Per-centage non-relapses	Number of cases	Re-lapses	Non-re-lapses	Per-centage relapses	Per-centage non-relapses
C17 Ross treatment	44	26	18	59·0	41·0	None	..	..	..	..
Oral quinine and galyl	25	18	7	72·0	28·0	14	4	10	28·5	71·5
Intramuscular quinine and galyl	21	15	6	71·4	28·6	37	13	24	35·1	64·9
Ravaut's treatment	22	15	7	68·1	31·9	22	8	14	36·3	63·7
Oral quinine, 45 gr. one month	18	8	10	44·4	55·5	{ Numbers too small to analyse in two series. Of total: 16 admitted previous to July 1, 18 after				
Oral quinine, 20 gr. one month	16	10	6	62·5	37·5					
Double intensive intramuscular	24	17	7	70·8	29·2	34	6	28	17·6	82·4
Double intensive oral quinine	0	..	..	..	..	49	15	34	30·6	69·4
Double oral quinine and cacodylate of soda	0	..	..	..	..	25	8	17	32·0	68·0
Week-end, 30 gr. ..	0	..	..	..	..	58	13	45	22·4	77·6
Week-end, 45 gr. ..	0	..	..	..	..	21	8	13	38·1	61·9
Control	17	13	4	76·4	23·6	27	17	10	62·9	37·1

Five methods of treatment were employed throughout the whole period. The continuous oral courses are disregarded, as the total numbers for any one period are too small to allow of accurate comparison. The four methods remaining are the oral quinine and galyl, the intramuscular quinine and galyl, Ravaut's treatment, and the intensive intramuscular course. By all these methods the percentage of non-relapse cases is very much higher amongst the second group of cases. In the first group the highest percentage of non-relapse cases is 31·9 per cent; in the second group the highest percentage of non-relapse cases is 82·4 per cent. In the control series the second group of cases also shows a higher percentage of non-relapse cases. Regarding the figures as a whole we find that in the first group of cases the percentage of non-relapse cases is low, and that in the second group of cases the percentage of non-relapses is high no matter what method is used.

Lieutenant-Colonel Wenyon, C.M.G., R.A.M.C., has kindly supplied

a curve showing the calculated number of benign tertian and malignant tertian cases in hospitals throughout 1917 and 1918 (see Part I).

It will be noted that in the 1918 benign tertian curve the maximum is attained in the middle of June and from that point onwards there is a rapid decline in the number of benign tertian admissions to hospital. The date at which the curve attains its maximum corresponds closely with the date fixed upon for the division of the cases into two groups. The latter date was arrived at from an analysis of the figures and only afterwards compared with the curve.

Provided that the number of troops in the area remains constant we may deduce that, apart altogether from the question of treatment, there is a natural tendency for the benign tertian infections to become quiescent during the later part of the year. The results of treatment are thus intimately connected with the natural rise and fall of the benign tertian curve. Cases treated at a period of the year when the curve is rising, no matter what is the treatment, will show a high percentage of relapses; cases treated when the curve is falling will show a high percentage of non-relapses. An examination of the previous history of a number of cases of benign tertian malaria led to the same conclusion. Many of these cases relapse frequently during the hot season; during the cold season, the relapses become much less numerous or even disappear, to commence again in the early part of the year long before reinfection is probable.

This seasonal variation is at least one of the factors in explaining the differences obtained in the results of treatment at home and the results obtained in Salonika.

It should be strongly emphasized therefore that the results of treatment can be compared only when the same types of case are treated in the same place and at the same time of the year.

If we compare the results of the different methods of treatment under Group I, excluding the continuous oral course, we find that there is very little to choose between the different methods of treatment. All give relapses varying from fifty-nine to seventy-two per cent. The lowest relapse percentage is given by the C17 treatment. Again between the treated cases and the control cases there is not a great difference. It has to be borne in mind, however, that the treated cases showed only one relapse after treatment, while many of the control cases relapsed two, three or more times within the same length of time.

If we compare the results of treatment under Group II, we find again that there is not a great deal of difference between the results of the various methods. The highest percentage of non-relapses is given by the double intensive intramuscular course, and the next highest is the thirty-grain week-end series. On the other hand, the treated cases in this group show a very much higher percentage of non-relapses than does the control series. In the control series the non-relapses amount only to 36 per cent, while the treated cases show from 63 to 82 per cent of non-relapse cases.

From a consideration of all the methods of treatment which have been used, it is recommended that these cases should be treated by a short intensive oral quinine course and the treatment carried on for not less than eight weeks, by thirty grains on two successive days weekly.

This refers only to one type of case, viz., the chronic relapsing benign tertian infections without acute symptoms.

To the medical officers in the special malaria wards, Captain T. Winning, Captain G. A. Johnstone, Captain I. D. Ramsay and Captain W. B. Whamond, I am greatly indebted for the skill and attention to detail with which they have carried out the various methods of treatment, and the care with which they have kept the records.

To Colonel Phear, A.M.S., to Lieutenant-Colonel Falconer, D.S.O., R.A.M.C., and Lieutenant-Colonel Wenyon, C.M.G., R.A.M.C., I am indebted for much valuable assistance and advice.

THE BOTANY AND NATURAL HISTORY OF THE DYKE-LAND NEAR SANDWICH, KENT, AS FAR AS THEY CONCERN MEDICAL ENTOMOLOGY.

BY MAJOR J. E. M. BOYD.

Royal Army Medical Corps.

Officer in Charge, War Office Entomological Laboratory, Sandwich.

THE original intention, on commencing this article, was to give a short description of the various diptera of medical importance found here, but it is now thought that perhaps a few other matters which are more or less closely connected with entomology may prove of interest: such as the natural history of the dykes and marsh-land.

When the laboratory was opened, it was intended that it should be used as a base for field work in the surrounding country, and also for the instruction of such officers as might be sent here; both the above purposes have been carried out during the period under consideration, in addition to work in the laboratory itself. The period being from April 1, 1920, to January 31, 1921.

Situated as it is, in Richborough camp, about one mile to the north of Sandwich, it is a most admirable spot for the study of the habits of mosquitoes and other diptera. The surrounding country has already been often described, so it will be sufficient to say that it consists of marsh land, intersected by dykes, which are used for the purpose of draining the land, for watering cattle, and in the place of fences.

The dykes, when low, are fed from the river, which is tidal, and when high, are allowed to run out into the river. Owing to this method of filling the dykes, there is at times a considerable amount of saline matter in the water, due to the river being tidal and not very far from the sea.

CLIMATIC CONDITIONS.

The weather throughout the period with which this article deals, has been most variable, warm dry spells alternating with cold and wet. On several occasions whole series of outdoor experiments have been spoilt by rain and heavy winds; which have either flooded the boxes, or have blown away the coverings, thus drowning the larvæ or releasing adult stages.

The botanical observations have been chiefly connected with the part played by each plant as regards its being acceptable, or otherwise, to the local Anophelines in their selection of suitable places in which to oviposit.

Larvæ have been found in the majority of the dykes and no particular plant can be picked out as being a marked repellant to the mosquito.

Azolla filiculoides has been stated to be of some use in this respect and certainly where the growth of this plant is marked no larvæ have been found, probably for the reason that the growth is so thick that the mosquito cannot find a space of clear water on which to oviposit; but, in an outdoor breeding pool, in which there has been *Azolla* throughout the year, purposely prevented from spreading too thickly, over the surface of the water, larvæ of *Anopheles maculipennis* have frequently been observed. The ova from which the larvæ emerged were laid by "wild" mosquitoes. Once the ova have been laid the plant does not appear to have any harmful effect on the larvæ or pupæ, the normal process of development being carried out.

Experiments with A. maculipennis, as regards the value of *Azolla filiculoides* as a deterrent to laying.—Three 3½ inch Petri dishes were placed in the breeding cage; each contained an equal quantity of water. One contained plants of *Azolla filiculoides*, the second pieces of *Entomorpha intestinalis*, and the third, water only. The number of eggs laid in each was as follows :—

			Water and azolla			Water and entomorpha			Water only
July 3, 1920	..	..	about 1,000	..	..	100	..	..	200
" 5, 1920	..	..	" 400	..	..	300	..	..	300
" 8, 1920	..	..	" 400	..	..	300	..	..	150
Totals	..	..	1,800			700			650

It is of considerable difficulty to decide what individuals of the animal kingdom to include in this article, as so many have a more or less important bearing on the subject, so it is proposed to mention only those which have been met with in carrying out the work here. To commence with the vertebrata.

The mammals which have supplied material are hedgehogs, rats, mice, moles and stoats; all these have been caught at various times and specimens of fleas obtained from each. The method employed to obtain the fleas is to chloroform the animal under a glass bell-jar until the fleas drop off their host. It then depends on the species of animal as to whether the anæsthetic is continued or not; as a rule only rats and mice are killed, the others being permitted to recover, after which they are released. Recently five black rats have been caught but only one flea, *Ceratophyllus fasciatus* (♀) was obtained. Four of these rats are now in a cage in the laboratory.

Rats are also of some entomological importance in that water-rats, in swimming across the dykes leave tracks in the weeds, which in still water may afterwards act as a breeding place for mosquitoes.

Certain domestic animals, as horses, cows and sheep, may be included, as these are turned out on the marsh-land to feed. They all when watering leave hoof marks on the sides of the dykes in which larvæ are found. The sheep also provide specimens of *Melophagus ovinus*, a wingless diptera commonly known as the "sheep tick" or "ked."

BIRDS.

Many wild ducks are to be found in the dykes at times and they are supposed to be of use in the keeping down of mosquito larvæ and undoubtedly help at any rate by disturbing the weed and so allowing small fish to attack the larvæ.

A rather amusing story was told last year. Inquiries were being made as to whether it was thought that ducks were of any use in this respect and one of the local officials, who had some tame ducks on a dyke near his office, said that in his opinion they were of little use, as his ducks were so frightened of the water-rats that they rarely went into the water, spending most of their time shivering on the banks. A young house martin was dissected and was found to contain specimens of *Calliphora*, *Lucilia*, *Syrphidæ* and other diptera, also a few small beet

The nests of the following birds were obtained during the summer and were examined for fleas and their larvæ—meadow pipit, blackbird, skylark, starling and sparrow. The usual procedure was to mark down the nest and leave it until the young birds had flown, and so the nests were usually found to be in a filthy condition. Some hundreds of flea larvæ were obtained from two meadow pipits' nests, the ground nesting birds seeming to produce the most fleas. An old blackbird's nest was taken in December in order to ascertain, if possible, how the bird fleas passed the winter. On examination two adult fleas (*Ceratophyllus*) were found and many cocoons. The nest was placed in the warm room and fleas hatched out of the cocoons almost daily, so apparently the fleas overwinter in the pupal state.

Whilst mentioning this nest, it may be of interest to say that numbers of small hymenopterous flies (*Chalcids*) were found alive in the adult stage. As these flies are parasitic on the lepidoptera, it appears strange, that whereas their hosts pass the winter, in most cases, in the pupal stage, these parasites appear as adults.

REPTILES.

Reptiles are not common, only the grass snake has been seen by us; the ground is probably too wet for vipers. There is in the laboratory a "slow-worm" taken from behind the military hospital in October, 1918. No lizards have been seen.

Beyond the fact that reptiles eat insects, they need not be considered here, as they eat both beneficial and harmful species.

BATRACHIANS.

Frogs, toads and newts are often met with: here again their diet consists chiefly of insects, but they do not discriminate between useful and harmful species, though the young frogs and newts certainly eat the larvæ of *chironomus* in large numbers.

FISHES.

Sticklebacks abound in the dykes and are known to eat mosquito larvæ in fair quantity. A number of these fish were dissected and eighty per cent were found to contain portions of anopheline larvæ in their stomachs. It is unnecessary to say more here, as an article on this subject appeared in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, in November, 1920, which gave full particulars of the stomach contents.

Young eels also abound in the dykes; they are known to eat chironomus larvæ, but it could not be proved that they also eat mosquito larvæ, it is quite possible that they do.

Roach, dace, chubb and bream are reported to be found in the dykes, but I have not seen any so far. In one dyke, at least, small flat fish exist, several specimens having been caught.

The vertebrates having now been dealt with, it is necessary to proceed to other branches of the animal world.

MOLLUSCA.

Species of Planorbis and Limnea can be found, the latter being very plentiful in some dykes. Tropical species of these are important, being the intermediate hosts of human parasites.

The Arthropods are of great importance, in that they contain the group Insecta. Leaving this important group until the last we have Crustacea, including the shrimps, prawns, water-lice, daphnia, cypris and cyclops, the latter being of medical importance, since some species are known to be the intermediate host of the guinea-worm.

There is no doubt that most, if not all, of these are of use in mosquito control. It has been found several times in this laboratory that when culicine egg rafts are placed in jars of water containing many daphnia and cyclops, the young larvæ disappear soon after they have hatched, whereas other larvæ in similar water, from which all the crustacea have been removed, thrive well after hatching.

Daphnia is also of interest, as it is possible under a low power to see the heart beating in the living creature, and also the method of development can be followed. The ova are contained in a cavity of the body until the embryos have developed, the parent then releases them and they swim away.

ARACHNIDA.

Mites and spiders of various kinds abound both on the land and in the dykes. Some of the water-mites are most beautiful, being bright scarlet in colour. No ticks have been obtained here, but a few were caught at Birchington, a few miles away, when sweeping grass for diptera. The water-mites are of interest, as many of the adult mosquitoes caught are infested with the larvæ of these. Between July 1 and November 30, 1920, 277 male and 3,956 female *A. maculipennis* were examined, of which four males and seventy females were infested—the total number of larval mites being 486. The most found on one mosquito, a female, was thirty-

three (July 22, 1920). How these larval mites become attached to the mosquito has yet to be ascertained; the mosquito only takes a few moments to emerge from the pupal case once the latter splits. None have been seen here on the larvæ or pupæ, though it is stated that they do attack these, nor have they been found on any other species than *A. maculipennis*. That they are aquatic has been proved by drowning infested mosquitoes in water, the larval mites then leave the dead body and in a few days develop into a later stage.

MYRIAPODA.

A few centipedes and millipedes are found occasionally when searching under rubbish for dipterous larvæ.

INSECTA.

Naturally many species of the various orders of this large and important group are found, and it may be of interest to take each order in turn, enlarging on those of medical importance and ignoring others which are of little importance or interest.

In this respect it may be well to follow the arrangement given by Colonel Alcock, C.I.E., in his book "Entomology for Medical Officers":—

(A) Orders which include species that "bite" or sting man or in some way threaten his health.

(1) Diptera (flies). This order is by far the most important in medical entomology, including as it does the Culicidæ (mosquitoes), Muscidæ (house fly group), and Psychodidæ (moth flies).

The species of Culicidæ found here are:—

- (1) *Anopheles maculipennis*.
- (2) *Anopheles bifurcatus*.
- (3) *Culex pipiens*.
- (4) *Theobaldia annulata*.
- (5) *Theobaldia (Culicella) fumipennis*.
- (6) *Theobaldia (Culicella) morsitans*.
- (7) *Ochlerotatus rusticus*.

Of these the two *Anopheles* are of importance, both being known carriers of malaria.

Anopheles maculipennis.

This species is by far the more common of the two *Anopheles* found, the larvæ abound in most of the dykes throughout the summer months, and adults can be found in occupied cowsheds and stables throughout the year, resting on the walls, rafters and ceilings in the darker spots. The incidence of the males is seasonal.

Unfortunately the only figures available, of captures, are from July to January. These are as follows:—

1920	July	..	49 males	..	950 females
	August	..	76 "	..	957 "
	September	..	106 "	..	1,082 "
	October	..	43 "	..	781 "
	November	..	3 "	..	236 "
	December	..	— "	..	12 "
1921	January	..	— "	..	78 "

The figures for the last two months of the year are of interest, firstly, because three males were caught in November, two on the 2nd, and another on the 10th, these dates being later than is generally recorded. Lang, in his "Handbook of British Mosquitoes," gives about the middle of October as the latest date. Secondly, because of the great decrease in the number of hibernating females collected in December; this point is of the greatest importance, since it shows what can be done by persistently visiting the hibernating places, and undoubtedly must be considered in all anti-mosquito work. The destruction of these hibernating females must lead to a very marked decrease in the number of mosquitoes, in a given area, in the following spring. There are two farms near the laboratory, which have always yielded a good supply of specimens during the winter months; one has been thoroughly cleaned and whitewashed, and on referring to my diary I find the following entry "December 20: Not one hibernating mosquito could be found at either Hooker's or Lawrence's farms." "December 21: after searching four farms one female *A. maculipennis* was found." These were the farms which were constantly visited.

In January there was a slight increase in the numbers collected, this was probably due to the warm weather, which tempted the females from other buildings.

The first males were caught on May 28, and the last, as stated above, on November 2 and 10.

Regarding the hours of feeding, females have "bitten" at all hours during the day, in the laboratory, and I have been "bitten" at home between 7.30 and 8 a.m. on a bright sunny morning.

On summer evenings males have been seen swarming over sun-flowers and other plants; on one occasion (September 10), a mixed swarm of *A. maculipennis* and *C. pipiens* was noted. On the approach of a female, the males become excited, the female flies into the swarm and on being caught by a male, is fertilized, the male then returns to the swarm.

Ova have not been found in the dykes, as being laid singly they are not so easy to find as the egg rafts of *Culex*. In the laboratory, at a mean temperature of 60° F. ova were laid up to November. During May infertile ova were laid in the breeding room on six occasions, no reason could be found for this. Ova will not survive drying.

Larvæ: these may be distinguished from the larvæ of other British Anophelines in that the outer anterior clypeal hairs are branched, whereas in *A. bifurcatus* and *A. plumbeus* these hairs are simple.

The earliest date on which these were found in the dykes, near the hibernating places, was on April 30, and near the laboratory on May 27; as there is no hibernating place near by, these probably belonged to the second brood of the season.

The water in which these are found varies from fresh to saline. Macdonald mentions them in water containing up to 339 parts of chlorine

per 100,000. Some were found, on one occasion, in a rain-water barrel, at Stonar House, and others in a solution of horse manure, used for breeding *Aedes calopus*, in the breeding room; there was no reason why this water should have been selected by the female, as there were several vessels of clean water available on the bench, in close proximity to the one chosen; the development of these larvæ was rapid and they emerged safely. Some form of vegetation must be present in the water, in the wild state, to provide cover and food for the larvæ.

When feeding on the surface, the larva turns its head completely over, so that the vertex is pointing downwards, it then sweeps the surface with its mouth brushes thus forming an eddy, which draws all small particles towards its mouth. It then either eats or discards whatever is drawn in, and then turns its head back to the normal position.

Attempts were made to find out whether the larvæ were cannibals or not; four large and eight small larvæ were placed in a sterilized Petri dish, containing distilled water, the dish was then covered. Nothing was noticed until the second day, when the empty skins of three small larvæ were seen in the dish; on the next day two more skins were noted, one of them being held by one of the large larvæ, in its mouth; on the fourth day all were dead, owing to some interested person having stirred the water with a brush, on which there was some xylol. It was not ascertained whether the large larvæ had killed the smaller or if the latter had died and had then been eaten, it is also very doubtful if the large larvæ would have interfered with their smaller comrades, even when dead, if there had been any other food available, since in the wild state all stages are found living together in apparent harmony.

The latest date on which larvæ were found in the open was on November 16.

The life history of *A. maculipennis*, as worked out in the laboratory was as follows :—

Ova laid	September 9, 1920 ..	—
Ova hatched	„ 11, „ ..	2 days
Larvæ pupated	October 2, „ ..	22 „
Adults emerged	„ 7, „ ..	5 „
Total .. ..	.. ..	29 days

The usual period given for the whole course of development is eighteen to twenty days, the delay in the laboratory experiments has probably something to do with the food supply.

(To be continued.)

THE SEROLOGICAL DIFFERENTIATION OF SOME STRAINS OF *BACILLUS DIPHThERiÆ*.

By MAJOR (TEMPORARY) A. S. G. BELL.
Royal Army Medical Corps.

LESIEUR in 1901, by injecting the goat with *Bacillus diphtheriæ* made an agglutinating serum.

Schowne in 1902 produced two sera from the horse, which agglutinated forty-five and fourteen strains respectively.

In the same year M. Gordon made diagnostic sera from guinea-pigs, and established on serological grounds the essential difference between *B. diphtheriæ* and *B. Hoffmanni*.

In 1903 Schick and Ersetting, working with fifty strains and using a diagnostic serum procured from the horse, found that the whole fifty were agglutinated by it to a dilution of 1 in 2,000; apparently only one type was present.

More recently, P. Durand dealing with emulsifiable strains only, by an application of agglutination and absorption tests, divided 237 strains into five groups containing approximately 8 per cent, 3·5 per cent, 13 per cent, 32 per cent, and 21 per cent, leaving 22·5 per cent unclassified. The serum was obtained from horses; P. Durand considered that the rabbit gave a non-specific serum.

L. C. Havens examining 206 strains, found that every one could be agglutinated by one or other of two sera he had made, eighty-two per cent and eighteen per cent respectively. Further, he was fortunate enough to find that all these strains agglutinated to full titre (1 in 4,860).

W. Park states that Williams and Mann, working with seven strains, found that they represented three distinct agglutinative types.

Major Mason describes how he made a monovalent serum which agglutinated sixty-four out of sixty-five strains submitted to it.

The following table gives a summary of the work of those observers who dealt with fifty or more strains:—

	Number of strains		Percentage typed		Percentage inagglutinable		Number of types found
Schick and Ersetting ..	50	..	100·0	..	—	..	1
P. Durand ..	237	..	77·5	..	22·5	..	5
L. C. Havens ..	206	..	100·0	..	—	..	2
Major Mason ..	65	..	98·0	..	2·0	..	1

The investigation about to be described was carried out in one of the laboratories of the Vaccine Department, Royal Army Medical College, and was an endeavour to ascertain which of these divergent serological classifications applied to the strains at present prevalent in the London district.

SOURCE OF MATERIAL.

One hundred and thirty-three strains were collected; three would not emulsify, leaving 130 to work with. A very large proportion of these, over ninety per cent, were isolated from swabs taken in the London area during the recent outbreak, the swabs of cases and carriers were used indifferently. One or two cultures, such as Park Williams 8 and B.W. 66 were sub-cultures of strains obtained years previously. Three were sub-cultures from American strains which L. C. Havens used in his investigations and which he had supplied to a London laboratory.

All the strains examined conform in certain particulars: they show the typical morphology and grouping and stain well with Neisser. All these characteristics are present when a twenty-hour growth on Loeffler is examined. Further, all ferment glucose and maltose, but not saccharose.

A note on the virulence appears later.

METHOD EMPLOYED.

The well-known strain, Park Williams 8, which is so largely used in the manufacture of antitoxic serum, was first injected into a rabbit. With some difficulty a serum with a titre of 1 in 800 with its homologous antigen was obtained. All available strains were subjected to an agglutination test with this serum. From the strains which failed to agglutinate, selections at random were made; these were injected into other rabbits. Again, the agglutinating capacity of the resulting sera was tried on all strains: from those which failed to agglutinate further strains were taken and used as antigens.

By an extension of this method three strains were finally selected, the sera made from which agglutinated eighty per cent of the organisms submitted to them.

The three strains were the organisms tabulated below, with the percentage of the 130 bacilli which responded to each:—

Antigen	Type	Number	Percentage
Park Williams 8 ..	I ..	17 ..	13
B.W. 66 ..	II ..	8 ..	6
Andrews ..	III ..	80 ..	61
Untyped 25, or 20 per cent.			

The tables chronicling these agglutinations are too unwieldy to be recorded in print. A short analysis shows that—

Each of the sera employed gave a titre of 1 in 400 with its homologous antigen.

Two-thirds of the organisms ascribed to type I went to full titre, the remaining third to sixty-six per cent of full titre.

Every member of type II agglutinated at full titre.

Of type III seventy-six per cent agglutinated at full titre, the remainder at sixty-six per cent of full titre.

In addition seven other sera were made which agglutinated members of the third group, leaving the first and second groups untouched. None of these seven agglutinated so large a number of type III as Andrews. Considering the results with three of them it will be seen that, when dealing with the 80 organisms assigned to type III the Andrews serum agglutinated 79, the Maloney serum 44, the Blackburn serum 64, whilst none materially affected groups I and II. As each of these three sera agglutinates and is capable of saturation with its own and the other two antigens, it is fair to assume that they all belong to the same type, viz., III.

When agglutination gives these results it is very difficult to say what are the percentages of the various types obtaining at any time, so much depends on using a catholic antigen. Unfortunately, the selection is dependent on chance alone. These remarks apply to the antigens used for type I and II sera.

The tables show that type II is a very clean-cut serological group. Agglutinins for this type are only present in the heterologous sera in low dilutions.

The same, though in a lesser degree, applied to type I. In six of the strains assigned to type III a considerable degree of agglutination is shown with type I serum.

These apparently non-specific organisms in every case absorbed the Andrews but not the Park Williams 8 serum.

A further examination of the table shows that 57 organisms were examined for virulence; 36 were virulent, 3 of these could not be classed; 21 were non-virulent, 5 of these were untyped.

Ninety-seven organisms were isolated from cases, eighteen, or eighteen per cent, were inagglutinable. Thirty strains were obtained from carriers, seven, or twenty-one per cent, were unplaced.

The three American strains fell into the first two groups, showing that the same serological types are to be found on both sides of the Atlantic.

ABSORPTION TEST.

One serum of each type was saturated with six homologous antigens, also with six heterologous antigens. In each case the six homologous strains absorbed the agglutinins from their homologous serum. The six heterologous strains used with the heterologous serum failed to remove the agglutinins though the titre was lowered about twenty per cent.

THE TOXINS PRODUCED BY THE THREE SEROLOGICAL GROUPS.

At this stage it was clear that the results might have some bearing on the oft-raised question as to whether the toxins from the different types of diphtheria organisms are neutralized by the antitoxin in common use, made from the toxin yielded by Park Williams 8. Dr. Hartley, of the Wellcome Physiological Research Laboratories, who has had great

experience in dealing with toxins, kindly consented to undertake the investigation of this part of the subject. He informs me that as far as his results go at present, such a common antitoxin exerts a protective action against the toxins derived from members of the three serologically different groups. The importance of these observations is obvious, if further experiments confirm these first findings.

SACCHAROSE FERMENTERS.

Seven organisms, which were morphologically indistinguishable from the true *B. diphtheriæ* when grown on Loeffler for twenty hours, and which gave the typical staining with Neisser, but which fermented saccharose in addition to glucose and maltose, were examined serologically. They all failed to show agglutination with any serum which had been made (thirteen in all).

It is of interest in connexion with this to relate that two saccharose fermenters other than those just enumerated, were sent to us by a laboratory and were placed in group III. On a report being made to that effect, it was at once stated by the laboratory in question that these two cultures had, since they had been forwarded to the Royal Army Medical College, been found to be contaminated by a streptococcus which fermented saccharose, and that the pure culture of the diphtheria-like organisms, which had been agglutinated, only produced acid with glucose and maltose.

TECHNIQUE EMPLOYED.

The Manufacture of Diphtheritic Agglutinating Sera.—Two animals were tried, the guinea-pig and rabbit; the former failed to produce an appreciable quantity of agglutinin and was early abandoned.

Intravenous injections was the only method used with the rabbit; the chief difficulty was the heavy death-rate, but a secondary trouble is that though an animal survive, it may not yield a serum with a higher titre than 1 in 50. This was not considered sufficient and no serum with a lower titre than ++ 1 in 400 was employed.

It was found that cultures killed by heat (65° C.), though relatively non-toxic to the rabbit, have lost so much antigenic power as to be useless.

The method of injection was as follows: 1 c.c. of a 3 T.M. emulsion of an organism killed by heat, and 0.1 c.c. of diphtheritic anti-toxic serum were given; five days later 500 M. live organisms were given with the same dose of anti-toxic serum. This dose was repeated at five-day intervals for the first month, agglutinins appear about the end of the third week. During the second month the dose of the live organisms was doubled, the interval remaining constant.

During the third month the dose was again doubled (2 T.M.), the interval being still constant.

No dose was ever given without antitoxic serum. By this means a

titre of ++ 1 in 2,000 was twice reached, but a fair average from the animals which reacted and survived would be ++ 1 in 400.

The mortality, as stated, was heavy; sometimes the animals have no sign of illness, dying suddenly, more generally they lost weight considerably. The animal died in spite of the cessation of the injections.

The autopsy results were constant; macroscopically, the liver and cortex of the kidney were enlarged and pale, and the suprarenal capsules heavily injected.

Microscopically, the cells of the liver and kidney showed cloudy swelling and fatty degeneration.

Paresis of the skeletal muscles was present in only one animal, and possibly was not due to the *B. diphtheriæ*.

The idiosyncrasy of the animal appears to be the dominant factor, some animals responding to the treatment detailed above, others of similar age and weight subjected to similar conditions, giving poor or negative results. Probably the rabbit, though convenient, is not the best animal to employ.

Agglutination.—A 3 T.M. emulsion is mixed in equal volume with the several dilutions of sera, the tubes are then semi-submerged in Topley's manner in a 55° C. bath for four hours. A normal serum control is always used; in a small percentage of the organisms examined a certain amount of flocculation took place in this tube, but it is of such a different degree to specific agglutination that little interference with the reading of the racks is experienced.

The Manufacture of Emulsions used in Agglutination.—A 3 T.M. emulsion titred by opacity is employed. It is made from an eighteen-hour growth on pea flour agar (Gordon). The organisms are well swizzled and killed by heat (half hour at 65° C.). The heavier particles sediment, the supernatant portion is decanted and phenolated. If it be not smooth glass beads and a shaker are employed. This generally gives satisfactory results. The organisms remaining in suspension well over the four hours needed in the agglutination test.

Technique of Absorption.—To 4.9 c.c. of a 15 T.M. emulsion, 0.1 c.c. of each type of sera was added, the emulsion was then incubated for twenty-four hours at 37° C., then centrifuged, and the supernatant fluid used in the ordinary way as a 1 in 50 dilution of serum.

CONCLUSIONS.

(1) That at present there are at least three distinct serological strains in the London district, two of these strains are also present in the United States.

(2) That the serological properties are independent of virulence.

(3) That the serological properties of a strain are independent of its source, i.e., case or carrier.

(4) That saccharose fermenters are not true *B. diphtheriæ*.

(5) That the toxins formed by the three serological types identified in the above experiment are probably neutralized by a common antitoxin.

The Professors of Pathology, Royal Army Medical College, Colonel Cummins, C.B., and Lieutenant-Colonel Marrian Perry, have given me many valuable suggestions. Dr. Eagleton did most of the virulence tests. My assistant, Miss J. Lewis, by her careful work and energy contributed largely to such results as have been obtained.

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Clinical and other Notes.

ONE THOUSAND, ONE HUNDRED AND SEVENTY-THREE SERUMS TESTED BY THE FORMALIN REACTION FOR SYPHILIS.

By W. LESLIE WEBB, M.B., B.S., D.P.H.

Officer in Charge, Laboratory of Venereal Diseases, Uganda.

THE formalin serum reaction of syphilis was introduced by Gate and Papacostos.¹ They tested over 400 serums with this reaction and found that the results agreed in eighty-five per cent of the cases with the Wassermann reaction results. In this paper comparisons are not made directly with the Wassermann test on the same serums, as the latter test was performed on less than half the cases and was not then altogether reliable.

The serums tested by the formalin reaction in this series are considered under the following headings:—

Disease	Number of serums tested
Primary syphilis	108
Secondary syphilis	596
Tertiary syphilis	230
Latent syphilis	52
Known non-syphilitics	13
Probable non-syphilitics	47
Other diseases	26
All other cases	109

The results are compared with the Wassermann reaction results given by Colonel Harrison² in "The Diagnosis and Treatment of Venereal Diseases in General Practice," which are taken as representative of the accuracy of the Wassermann test as performed in England. These results are not favourable to the formalin reaction. The technique of this test is so simple that hopes of improving results by improving technique need not be considered.

Technique.—One cubic centimetre of the fresh unheated serum to be tested is placed in a clean test tube of about $\frac{1}{2}$ inch diameter. To it is added two drops of commercial formalin (forty per cent formaldehyde), and the contents of the tube are mixed by shaking. The mixture is left at room temperature (24° C. in the Mulago Laboratory) for from eighteen to twenty-four hours and then read. A positive reading shows solidification of the serum ranging in degree from that of a two per cent agar to that of a somewhat flabby table jelly. A negative serum remains liquid. In doubtful readings the serum remains liquid, but is thickened. As long as the serum will flow down an inverted tube, however reluctantly, the reading is not positive. In very strongly positive cases, the serum solidifies in a few minutes, and after twenty-four hours is opaque and rather like inspissated serum.

¹ *C. R. Soc. Biologie*, November 20, 1920.

² "Diagnosis and Treatment of Venereal Diseases in General Practice," second edition, by L. W. Harrison, D.S.O., K.H.P., Brevet Colonel, R.A.M.C.

In considering syphilitic cases which have been under treatment, the treatment received is expressed in weeks. The routine treatment of all syphilitics here consists of weekly intramuscular injections of mercurial cream, supplemented by intravenous injections of salvarsan substitutes as occasion demands and when available, and by intravenous injections of antimony tartrate two or three times a week in a number of tertiary and a few primary and secondary cases. The native of Uganda is intolerant of mercury, and the weekly intramuscular injection consists of $\frac{1}{4}$ grain of the metal. The therapeutic effect of this dose appears analogous with that of a dose of one grain given to an Indian or a European.

Primary Syphilis.—The serums of 103 primary syphilitics were tested. Of these, eighty-five, both treated and untreated, showed active signs of disease, and gave the following results:—

		Positive		Doubtful		Negative		Total
Number ..	..	58	..	7	..	20	..	85
Percentage	..	68.25	..	8.25	..	23.5	..	—

This compares favourably with the percentage of 69.4 positive Wassermann reactions given by Harrison in 2,596 cases. The number of serums tested were, however, too small to justify definite conclusions as to the value of this test on primary syphilis. No attempt was made to take into account the duration of the chancre, as the histories given by the natives are not reliable.

Of 18 serums of primary syphilitics who under treatment had lost all active signs of disease, 5 were positive to the formalin reaction, 2 were doubtful, and 11 were negative. The average duration of treatment of these eighteen cases was $7\frac{1}{2}$ weeks.

Secondary Syphilis.—The total number of serums tested was 596. Of these, 427 showed active and undoubted signs of secondary syphilis. The readings are:—

		Positive		Doubtful		Negative		Total
Number ..	..	347	..	13	..	67	..	427
Percentage	..	81.3	..	3.0	..	15.7	..	—

Of these 427 cases, 314 were untreated.

		Positive		Doubtful		Negative		Total
Number ..	..	279	..	5	..	30	..	314
Percentage	..	88.85	..	1.6	..	9.55	..	—

Thirty-seven had received less than one month's treatment, the average duration of treatment being two weeks.

		Positive		Doubtful		Negative		Total
Number ..	..	26	..	3	..	8	..	37
Percentage	..	70.3	..	8.1	..	21.6	..	—

The remainder of the cases with active signs had been under treatment for over a month, the average period being 6.8 weeks.

		Positive		Doubtful		Negative		Total
Number ..	..	42	..	5	..	29	..	76
Percentage	..	55.3	..	6.6	..	38.1	..	—

The average duration of treatment of the forty-two cases was six weeks. Of the doubtful cases seven weeks, and of the negative cases eight weeks. One hundred and sixty-nine cases who had been under treatment for an average period of 6.5 weeks and who exhibited no signs or symptoms of active disease, gave the following results:—

Number ..	..	Positive 85	..	Doubtful 12	..	Negative 72	..	Total 169
Percentage	..	50.3	..	7.1	..	42.6	..	—

The average duration of treatment of the cases which gave a positive reaction was 5.3 weeks, for the doubtful and for the negative cases eight weeks each. Of 2,449 cases of untreated secondary syphilis and of 4,556 serums of all cases of secondary syphilis quoted by Harrison, the percentage of positive Wassermann reactions was 97.1 and 90.1 respectively. The results of the formalin reaction compare very unfavourably with this. The formalin reaction figures for secondary syphilis are in two cases too low to be expressed legitimately in percentages. But this has been done to emphasize the remarkable drop in positive reactions effected by treatment. A drop of from 88.85 per cent in untreated cases to 70.3 per cent for cases of an average treatment of two weeks, and again to 55.3 per cent for cases under treatment for an average time of 6.8 weeks, all with active signs of disease, is of interest as indicating a certain specificity of the reaction for syphilis, but reduces its value as an indicator of the effect of treatment. A percentage of 50.3 positive in 169 cases of secondary syphilitics who show no signs or symptoms of active disease, after having undergone treatment for an average period of 6½ weeks only, cannot be a true picture of the effect of such a short period of treatment on the disease. No one of these cases had been under treatment for more than sixteen weeks or for less than four weeks.

Tertiary Syphilis.—The cases of tertiary syphilis include active congenital syphilis in adults. The histories of disease given by natives are unreliable, and it is usually difficult to differentiate between the tertiary symptoms of acquired syphilis and active manifestations of congenital syphilis. Two hundred and seventeen serums of natives suffering from active tertiary syphilis were examined.

Number ..	..	Positive 163	..	Doubtful 16	..	Negative 88	..	Total 217
Percentage	..	75.1	..	7.4	..	17.5	..	—

These fall into six groups:—

(1) Ulcers, gummata, orchitis, onychia, periostitis, arthritis and other active tissue destruction or infiltration.

Number ..	..	Positive 80	..	Doubtful 3	..	Negative 9	..	Total 89
Percentage	..	89.9	..	3.4	..	6.7	..	—

(2) Tertiary skin affections of minor degree, and adenitis. These are taken separately, as they are minor manifestations and are often not complained of by the patient, who has attended for some other disease.

Number	Positive 22	..	Doubtful 1	..	Negative 7	..	Total 30
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(3) This small group consists of two conditions known as "bikata" and "nungu." "Bikata" is a scaly condition of the hands with loss of pigmentation and with thickening and sometimes cracking of the epidermis of the palms. "Nungu" which includes a rupial condition of the feet, is in this series of cases only represented by deep and painful fissures of the soles of the feet, often associated with the thickening of the epidermis.

Both by the natives and by the medical profession in Uganda these are regarded as late manifestations of syphilis. But the connexion does not seem

as clear as in other more common lesions, and so I have separated them into a group by themselves.

	Positive	Doubtful	Negative	Total
Number ..	6	8	5	14

(4) Myalgia, ostealgia and other subjective symptoms associated with a history of previous syphilis and considered by the natives to be syphilitic. Pain in the bones and muscles is one of the commonest manifestations of tertiary syphilis amongst the natives. It is so generally insisted upon by them as being syphilitic, and reacts so satisfactorily to antisyphilitic treatment, that little doubt as to its nature can exist.

	Positive	Doubtful	Negative	Total
Number ..	46	9	17	72
Percentage	63.6	12.5	23.9	—

(5) Nine cases of tertiary syphilis exhibiting nervous symptoms were examined. Six gave a positive reaction, and three a negative.

(6) Three cases of tertiary syphilis of which no details could be traced gave a positive reaction.

The serum of thirteen cases of tertiary syphilis who under treatment had lost all signs and symptoms of disease were examined. Of these 7 gave a positive reaction, 1 a doubtful reaction, and 5 were negative.

The percentage of positive formalin reactions for all cases of active tertiary syphilis was 75.1; hardly any of them had received treatment. The eighty-nine cases of active tertiary syphilitic tissue destruction or infiltration provide the highest percentage of positives of the whole series, i.e., 89.9. In 255 cases of untreated tertiary syphilis tested by the Wassermann reaction and noted by Harrison, the percentage of positive reactions was 98.4, and in all cases of tertian syphilis was 82.9.

Latent Syphilis.—Fifty-two serums of latent syphilitics were examined; 33 gave a positive reaction, 2 a doubtful, and 17 a negative reaction.

Known Non-syphilitics.—Dr. A. R. Cook, of the C.M.S. Hospital in Uganda, estimates that about seventy per cent of the total adult native population is tainted with syphilis, either congenitally or directly acquired. No native serums were accepted as negative controls. Thirteen serums of Europeans who were known to be non-syphilitics were tested, and all were negative.

Probable Non-syphilitics.—Forty-seven serums of educated and intelligent natives who showed no signs of disease, who were personally known to us, and who almost certainly had not suffered from acquired syphilis in adult life were tested and gave the following results:—

	Positive	Doubtful	Negative	Total
Number ..	5	3	39	47

Other Diseases.—The results of the formalin reaction in cases of other diseases are not reliable, as the greater number of serums were sent from other hospitals, and no positive or negative history of previous syphilis could be obtained. Of 16 cases of yaws, 8 gave a positive reaction and 4 each doubtful and negative reactions. A Eurasian leper, known to be non-syphilitic, gave a negative reaction. Two cases of surgical tuberculosis, and one case each of cerebrospinal meningitis, scabies, hydrocele, arthritis and boils each gave a positive reaction. A case of bronchitis, and a case of multiple fibromata gave doubtful reactions. This may

or may not favour a suspicion I have that the formalin test is liable to give a positive reaction in a certain number of cases of toxic absorption from any source. I have not been able to test this on known non-syphilitic Europeans suffering from such toxæmias.

The remaining serums consisted of a number of cases of venereal sores, rashes, etc., which were not diagnosed clinically and ceased attendance before a diagnosis could be established.

	Positive	Doubtful	Negative	Total
Number ..	74	7	28	109

The following table shows a comparison between the results of the formalin reaction in this series of cases, and of the Wassermann reaction as recorded by Harrison :—

Stage of disease	Wassermann reaction		Formalin reaction	
	Number of cases	Percentage positive	Number of cases	Percentage positive
Primary	2,596	69·4	85	68·8
Secondary untreated	2,449	97·1	314	88·9
„ all cases	4,556	90·1	427	81·8
Tertiary untreated	255	98·4	217	75·1
„ all cases	1,869	82·9	—	—
Latent untreated	196	72·9	52	63·5
„ all cases	6,829	45·6	—	—

Even allowing for a certain amount of overlapping in the formalin results between the tertiary and the latent syphilitic serums, the results are not favourable to the formalin test. Only in the case of primary syphilitics, where the number of serums tested was too small to give reliable figures, do the results approach the accuracy of the Wassermann findings.

Conclusions.—It would appear that, although the formalin reaction exhibits a specificity for syphilis, it is inclined to give, in all stages of the disease, a much lower percentage of positive reactions than the Wassermann test.

In secondary syphilis, the effect of treatment would seem to be reflected in an exaggerated degree on the formalin reaction results, and the readings tend to become negative in rapidly increasing percentages as treatment continues, even while the disease is still active.

In no serum of known non-syphilitic origin, did the formalin reaction give a positive reading, but the number of these cases was so small as to render any conclusion uncertain.

In common with the Wassermann and the Sachs-Georgi reactions, the formalin reaction tends to give a positive reading in cases of yaws.

The formalin reaction is not delicate enough to be useful in the diagnosis of syphilis, nor to furnish a reliable guide to treatment.

Although of ideally simple technique my experience of the test does not incline me to continue its practice.

In conclusion, I wish to record my thanks to Major Keane, D.S.O., Specialist Officer, Venereal Diseases, Uganda, for his help in the revision of this paper, and to Major Wiggins, P.M.O., Uganda, for permission to publish it.

SUGGESTIONS FOR A NEW ESTABLISHMENT FOR A FIELD AMBULANCE.

By CAPTAIN G. P. KIDD.
Royal Army Medical Corps.

EXPERIENCE has shown, I think, that the present establishment of a field ambulance as laid down in war establishments was not altogether suited to the conditions of modern warfare which prevailed during the past war.

The old arrangement of having the field ambulance divided into three sections, each practically a self-contained unit in itself, proved satisfactory enough when the fighting was more or less stationary, i.e., in the period of trench warfare in France and Flanders, as then the sections of the ambulance could "work the line" in turn and so relieve each other periodically. But when the fighting became of a more or less "open" nature and continual movement was taking place, it was found that this "sectional" arrangement did not work, especially as single brigades were seldom detached from the division to operate independently.

The chief reason for this, I think, was that the bearers of one section (i.e., one "bearer subdivision" as laid down in war establishments) were never sufficient to cope with the work on even one brigade front, and in most cases all the available bearers of a whole, if not of more than one, ambulance had to be utilized. It seems to me therefore that a more satisfactory scheme would be to emphasize the division of the ambulance into a "bearer" division and a "tent" (or "nursing") division rather than into three "sections," each containing "bearers" and "hospital personnel." It must be remembered though that the "tent division" may be required to run a "main dressing station" and an "advanced dressing station" at the same time; I would therefore suggest that the "tent division" be subdivided into two parts, a "headquarters" section, and an "advanced dressing station section." The "headquarters section" would then practically correspond to two, and the "advanced dressing station section," to one "tent sub-division" as laid down in the old war establishments.

We would then have, as before, *three* sections, but differently composed from the original ones, i.e.:

- (1) "Headquarters Section."
- (2) "Advanced Dressing Station Section."
- (3) "Bearer Section."

I have given below what I would suggest as the detailed "strength," for each of these sections, and I add the following remarks in explanation of my figures:—

(1) THE "HEADQUARTERS SECTION."

This would consist of the "headquarters" staff of the unit, together with all personnel from the "tent division" necessary to run a main dressing station or divisional rest station together with all the "specialists" usually employed with headquarters.

(2) THE "ADVANCED DRESSING STATION SECTION."

This would consist of just sufficient personnel from the remainder of the "tent division" to run an "advanced dressing station," and would be quite distinct from the "bearer section."

FIELD AMBULANCE.

Headquarters Section.

- 1 Lieutenant-Colonel (Officer Commanding).
- 1 Major (2nd in Command).
- 2 Captains or Lieutenants.
- 1 Quartermaster.
- 1 Serjeant-Major.
- 1 Quartermaster Serjeant.
- 2 *Staff-Serjeants* :—
 - 1 Dispenser.
 - 1 Clerk.
- 5 *Serjeants* :—
 - 2 Nursing.
 - 1 Clerk.
 - 1 Cook.
 - 1 Storekeeper.
- 2 *Corporals* :—
 - 1 Pack Storekeeper.
 - 1 Pioneer.
- 44 *Privates* :—
 - 12 Nursing Orderlies (including 2 Lance-Corporals).
 - 2 Clerks.
 - 2 Cooks.
 - 4 Pioneers.
 - 1 Pack Storekeeper.
 - 1 Storeman.
 - 1 Postman.
 - 1 Shoemaker.
 - 1 Tailor.
 - 1 Carpenter.
 - 1 Barber.
 - 1 Butcher.
 - 1 Washerman.
 - 1 Chiropodist.
 - 1 Cyclist Orderly.
 - 1 Office Messenger.
 - 1 Officers' Mess Cook.
 - 1 Serjeants' Mess Cook.
 - 4 General Duty.
- Category "B" Men* :—
 - 5 Officers' Batmen.
 - 1 Serjeant-Major's Batman.

Total.

5 Officers.
55 Other Ranks.

Total Royal Army Medical Corps Personnel.

9 Officers.
172 Other Ranks (including 20 Category "B" Men).

Advanced Dressing Section.

- 1 Major (Officer Commanding Bearers).
- 1 Captain or Lieutenant.
- 1 Nursing Serjeant.
- 1 Corporal Cook.
- 12 *Privates* :—
 - 4 Nursing Orderlies (including Lance-Corporal).
 - 2 Pioneers.
 - 1 Clerk.
 - 1 Cook.
 - 4 General Duty.
- Category "B" Men* :—
 - 2 Officers' Batmen.

Total.

2 Officers.
16 Other Ranks.

Bearer Section.

- 2 Captains or Lieutenants.
- 3 Bearer Serjeants.
- 82 *Privates* :—
 - 80 Bearers (including 3 Lance-Corporals).
- Category "B" Men* :—
 - 2 Officers' Batmen.

Total.

2 Officers.
85 Other Ranks.

Transport Section, R.A.M.C.:

- 1 Corporal Wagon Orderly.
- 1 Corporal Cook.
- 1 Private Cook.
- 3 Water-cart men.
- Category "B" Men* :—
 - 7 Car Orderlies.
 - 3 Horse Ambulance Orderlies.

Total.

16 Other Ranks.

(3) THE "BEARER SECTION."

This would consist only of bearers and would in action be based on the "advanced dressing station." It will be seen that I have put only eighty bearers (this giving twenty squads of four bearers each). This is as large a number as was ever really available under the old scheme, after all "specialists," etc., were deducted and is, I think, sufficient for any ordinary needs. I have included also in the "establishment" a small party of Royal Army Medical Corps personnel, which I call the "transport section," who would be more or less permanently attached to the transport (horse transport, and motor transport) of the unit, and the twenty "B" Category men who towards the latter part of the

war were apparently recognized as included in a field ambulance strength, ten of these being shown as "batmen," and ten as "wagon orderlies." The total strength, it will be seen, works out at nine officers and 172 other ranks, a reduction of ten on the old war establishment.

The non-commissioned officers also become slightly altered, both as regards their duties and in that the number of serjeants is reduced to nine and that of corporals to five.

This method of working the ambulance would, of course, necessitate some rearrangement in the method of packing the equipment on the transport. This can very easily be done so that a certain number of wagons are packed with all the equipment for the "headquarters section," while one limber is set aside for the equipment of the "advanced dressing station section," thus ensuring that the latter can always move independently when necessary.

Should the rare possibility arise of a whole section having to be separated for duty with an independent brigade, the headquarter section equipment can easily be divided into two almost identical sets and the wagons packed accordingly. In which case the personnel also for the independent section must be detailed from the original sections as considered necessary.

I may add that this method of working was adopted for over three years in the field ambulance in which I served in France, and proved very satisfactory in every way.

The question was raised in France as to whether a division could do with less than three field ambulances. I think that under existing arrangements three are necessary, but I have often thought that a good idea would be to have one "corps" field ambulance definitely attached to each corps and under the direct orders of the Deputy Director of Medical Service corps, as the motor ambulance convoys were in the later stages of the war on the Western Front. This "corps" ambulance could then do all such jobs as "corps main dressing station," "corps rest station," "corps scabies station," etc., when these were in existence, with assistance from the divisional field ambulances if necessary.

Under such an arrangement, I think that a division could do with only two field ambulances, and if (as was very rare in the war) the three brigades were operating independently, one ambulance could be split up.

With regard to the question raised in the recent correspondence as to whether the divisional field ambulances should remain directly under the orders of the Assistant Director of Medical Services, or be put under the orders of the General Officer Commanding Brigade is concerned, I think that for the purposes of medical operation orders and purely medical administration, the ambulances should certainly be directed under the Assistant Director of Medical Services. But that for questions such as "supplies," "discipline" and "quartering," they might easily be made an integral part of the brigade concerned. This would, for one thing, tend to lessen the routine work in the office of the Assistant Director of Medical Services and enable that office to concentrate on purely medical questions of administration.

Finally, with regard to the question of inter-communication between regimental medical officers, brigade headquarters, field ambulance headquarters and the Assistant Director of Medical Services, in my division during the period of "open warfare" we had a medical "liaison" officer from the field ambulance

attached to each advanced brigade headquarters, together with runners or mounted, or cyclist orderlies from the ambulance. By this means it was found far easier and quicker to get messages back to the ambulance headquarters regarding the position of regimental aid posts, etc., than if the messages had to go by signal, via battalion headquarters, brigade headquarters, divisional headquarters and Assistant Director of Medical Services.

In this connexion I entirely agree with your correspondent who suggests that every field ambulance should have a telephone set and the necessary signal personnel attached to it, at any rate during "open warfare."

Although it is perhaps rather late in the day (nearly three years after the war) to write on such a subject, I hope that the above notes may possibly be of interest especially in light of the recent correspondence on the same subject. I might add that the part of this article on the "proposed new establishment" of a field ambulance, was originally worked out by me in December, 1918, at the request of the Assistant Director of Medical Services of my division in France who had raised the point in question.

Lecture.

GAS WARFARE: ADOPTION: METHODS OF USE: PROTECTION OF TROOPS.

By MAJOR W. R. GALWEY, O.B.E., M.C., R.A.M.C.

INTRODUCTION.

THE legitimacy of the employment of noxious gas as a weapon of warfare has recently been much discussed in both the public and scientific press.

At the meeting of the British Association in Edinburgh in September the President in his opening address called upon the Association to use its every endeavour to persuade scientists to cease research into chemical methods of destruction as derogatory to the high call of science.

Much might be said regarding the humanity of inflicting casualties by gas rather than by high explosive, of the high percentage of permanent recoveries after the former as against the latter and the low percentage of deaths, but it seems to me that two fundamental facts are ignored by those who write and speak against gas warfare:—

- (1) That, in the highest sense, all weapons in war are inhuman, and
- (2) That the use of gas in warfare is an accomplished fact.

It has proved a most effective weapon, so that any nation fighting in the future for its existence must be prepared to combat it and use it. Research into new compounds capable of overcoming existing methods of defence can be carried out in secrecy in the laboratory without attracting the attention of foreigners—many of the poisonous compounds are intimately connected with the chemical

industries. Therefore it appears that so long as war remains the ultimate means of settlement of international strife, and until the League of Nations can enforce its mandates, so long must each nation continue to prepare for gas warfare.

Two facts are significant :—

(1) During the inquiry into German methods of making mustard gas which followed the Armistice one of the respondents asked: "Why are you worrying about this, when you know perfectly well that this is not the gas we shall use in the next war."

(2) Of the total American casualties, about 30 per cent were due to gas, and of these about 90 per cent were due to skin burns; of the gas casualties 3 to 4 per cent died and about 95 per cent recovered completely. The Americans have laid to heart the lesson taught by these figures and have established a chemical warfare service on a peace footing with a personnel numbering about 1,600 and have budgeted for an annual expenditure of 4½ million dollars for research into this branch of warfare.

Adoption.—In ancient times the Spartans in the fourth century B.C., used gas in the form of sulphur and pitch fumes against the Athenians.

Greek fire which is of the same nature was employed by the Byzantine Greeks against the Saracens and by the latter in turn against the Crusaders.

In modern times the first suggestion to employ this method of offence was made by Lord Dundonald. It was seriously advocated by the chemist, Lord Playfair, at the time of the Crimean War, as a humane method of overpowering the enemy, and the use of sulphur fumes was suggested as an aid in the reduction of the Redan Redoubt. The suggestion was considered by experts and dismissed as inhuman.

Later the Hague Convention, to which Germany was a signatory, practically forbade its use. It was the treachery of Germany in this case as much as the nature of the weapon she employed which raised the storm of execration against her in April, 1915.

At the end of the last century poisonous gases were investigated in Germany by Lehmann and his pupils with the ostensible purpose of making dangerous trades safe; but in this country although many of the compounds afterwards used had been met with in chemical research, practically nothing was known of their production on a large scale or of their action on the human organism. It is true, however, that useful work had been done prior to the war in South Africa by medical officers to mines in investigating cases of poisoning from nitrous fumes given off after the discharge of explosives in blasting operations.

The first German gas attack was made against the French and our 2nd Army in the Langemarcke sector on April 22, 1915. The surprise was absolute and our line simply ceased to exist, since those who did not retire were either killed or incapacitated. The Germans captured sixty guns and a large extent of territory. A second cloud gas attack was delivered in the same sector on April 24 and was chiefly directed against the Canadians. The Germans did not realize the power of the new weapon and neither used it over a sufficient extent of front nor followed up their initial success. Had they done so the war might have ended in a German victory by the summer of 1915.

The first attacks were quickly followed by others, some of which were on a large scale, during the months of April and May; all were in the Ypres sector.

The gas used in the early attacks appears to have been pure chlorine, though later phosgene was combined with it. It was delivered from steel cylinders each of which contained some forty-five pounds of compressed chlorine.

Gas attacks followed each other rapidly until May 24 and then there was a lull until December, 1915. The last cloud gas attack was on August 8, 1916.

Various statements have been made as to when the Germans first began to use lethal gas in projectiles. The earliest certain date is July, 1916, when lethal gas shells were used, and from that time the enemy developed this mode of attack more and more. In all he used no less than eighteen different gases against us and our allies. It is unnecessary to detail these and in my next lecture I hope to put before you a classification of war gases according to their pathological effects. It will suffice to say here that the three main types of gas shell were known as green cross, blue cross and yellow cross. The green cross contained phosgene alone or combined with such substances as chlorpicrin and chlorarsines. Green cross 3 contained various arsenic compounds. Blue cross contained chlorarsines, cyanarsines, and N. ethyl carbazol. Yellow cross contained dichlorethyl sulphide or mustard gas. At first gas shells were fairly easily distinguished from others owing to the small bursting charge they contained, but later they were mixed with bombardments of high explosives and the gas shells themselves contained large quantities of high explosives, so that it became difficult to say whether a bombardment was simple or mixed, and a constant outlook had to be kept for gas.

Gas warfare reached its zenith in 1917 when the Germans introduced mustard gas—a weapon, which although of minor importance from the point of view of death, causes a great number of casualties from its insidiousness and persistence and which can be used to render ground untenable by troops for considerable periods.

The last development was the use of large projectors which discharged by means of bombs, enormous quantities of gas over small areas, so that concentrations were arrived at when one breath incapacitated if it did not kill a man. The projector attack was introduced by the British in April, 1917, and adopted by the Germans in December of the same year.

I may mention that towards the end of the war our use of gas far surpassed that of the Germans, as our defence was better; so that they were very literally hoisted with their own petard, and must have bitterly regretted their treachery in introducing this weapon.

Methods of use.—As the science of gas warfare was developed, three definite purposes emerged for which this weapon is effective: (1) To inflict casualties; (2) To reduce the fighting efficiency of troops by compelling them to wear respirators; (3) To render positions temporarily untenable.

(1) The best substance to employ is that which answers the particular purpose of the General Staff, and the fact that a substance is lethal need not necessarily give it preference over one whose effects are only temporary and do not permanently incapacitate, but which quickly puts men out of action. Thus a lachrymator might in particular circumstances be more effective than phosgene.

The first gas attacks caused very numerous casualties but it is impossible to estimate numbers with any great degree of accuracy as so many men were killed

outright or died before they reached medical units. But as our defence developed the casualties diminished, so that in the last cloud attacks they were confined to units, and individuals, where gas discipline was slack or defensive apparatus was not properly cared for or adjusted.

With the advent of mustard gas the casualty list lengthened until the troops had again learnt how to combat this new evil.

(2) The second purpose for which gas is employed—to diminish the fighting efficiency of troops—is more difficult to combat. The respirator is uncomfortable to wear and if worn for any length of time the resistance to breathing and general discomfort diminishes the fighting and working power.

The greatest sources of discomfort are the mouthpiece and nose-clip, but so far it has been impossible to dispense with them. Intercommunication and accuracy in handling delicate instruments also suffer. Two examples will illustrate how efficiency is impaired :—

(i) It was noted that if, when shelled by the enemy, our batteries replied with gas shell in twenty to thirty minutes the accuracy of the enemy's shooting, as indicated by "overs," "duds," etc., was greatly diminished.

(ii) The French experimented to see how long men could wear respirators. An area was chosen in the rear where men were made to carry out light work or left at rest wearing respirators continuously and not even removing them for food or drink. The men were exposed to a gas, non-lethal, but causing intense lachrymation with the least dose. Forty-eight hours' leave was given to each man for every two hours he could stick it over six hours, but though a certain number of men managed to accumulate a considerable spell of leave the best result that could be obtained was that seventy per cent were efficient at the end of twenty-four hours. The French mask is more comfortable than ours.

(3) The third purpose for which gas is used is to render positions untenable. Mustard gas has so far given the best results on account of its persistence. It is therefore imperative when occupying a position which has been shelled to make certain whether gas has been used and to warn troops against handling objects which might be contaminated, and against drinking water contaminated by gas. Numerous casualties were caused in France by neglect of these precautions.

Though the means by which an enemy attains his object in a gas attack, i.e., gas tactics, is primarily the business of the General Staff and Gas Services, it is important that all troops, officers and men alike, should understand the general idea in the use of gas.

Cloud gas is used to inflict casualties and as a preliminary to an infantry attack.

The gases used must have the following properties :—

(1) Must be heavier than air ; (2) must be easy to liquefy ; (3) must be lethal in fairly low concentration.

Not many substances fulfil these conditions, and for this reason and because our protective measures had become almost perfect against it, the Germans abandoned the cloud attack.

Weather conditions must be closely considered with all kinds of gas warfare but they are particularly important in cloud attacks.

The best wind is a steady breeze from four to nine miles per hour, but attacks have been made with winds from two to twenty miles per hour.

The effects of cloud attacks has been felt as far back as twenty miles from the point of liberation, but the usual distance for serious casualties is five to six miles.

Heavy rain is unfavourable, but slight dampness keeps the gas low—fog gives opportunity for surprise.

Night time is most favourable both on account of surprise and because cold currents coming downward keep the gas low.

The usual number of cylinders employed was one per yard of frontage and the front attacked was about 3,000 yards.

An attack can be recognized by the hissing noise as the gas emerges from the cylinders and by the greenish colour (becoming white in damp weather) of the cloud in the case of chlorine.

Gas shells are used both for surprise attacks and to inflict casualties, and also to harass communications and prevent arrival of reinforcements. The news of a cloud attack can be quickly passed to the rear, but the gas shell is its own herald. In the last stages of the war the only way of recognizing gas shells was by the smell of the compounds they contained.

The projector attack combines the advantages of both cloud and shell and is more deadly because of the enormous concentration which it can give.

The projector discharge can be recognized by :—

(1) Noise on discharge—like an ammunition dump going up; (2) Flash along the line; (3) Whining noise of the drums in flight; (4) Sight of drums flying; (5) At night by the trail of sparks emitted from the drums.

For a big projector attack as many as 1,500 drums, each containing some thirty-one pounds of liquid, were used, one drum being sufficient to overcome the German respirator at the point of impact.

It has been well said that "Gas warfare resolves itself into a contest between offensive materials and protective devices, and there is no finality in regard to either; so that the chemical substances employed must necessarily vary from time to time, as well as the tactics adopted in using them."

Protection of Troops.—Though the first attack found us totally unprepared, efforts were at once made to counteract this new weapon. On April 23, under telephonic instructions from the Director-General Medical Services, General Headquarters, the Director of Medical Services, First Army, issued a circular recommending the use of a solution of bicarbonate of soda, which should be kept in buckets, etc., and that men should be instructed to use handkerchiefs or cloths dipped in the solution to cover the nose and mouth.

On the following days various other appliances were improvised; for instance, on 27th and 29th, Professors Haldane and Baker visited France, and the latter recommended the use of cloths, etc., moistened with urine, or of earth folded in cloth or enclosed in a bottle from which the base had been removed.

A German respirator captured at this time proved to be a pad of cotton-waste soaked in hyposulphite solution and contained in a gauze bag which was provided with tapes for tying over the face.

In the meantime the War Office authorities at home had turned to the Army Medical Service, and it was very largely due to the scientific knowledge and unflinching resource and energy in organization of Colonel Sir William Horrocks and Colonel Lelean that the menace to our troops was met and disaster averted.

It was known that for the moment chlorine was the gas to be dealt with and the chemical problem was therefore simple, though the provision of the appliances for making pads within a few hours was far otherwise.

However, so nobly was the call met that within sixty hours 98,000 pads of cotton waste in muslin containers, dipped in hyposulphite solution and dried, were available at the front; 300,000 were available in a week and 2,000,000 within a month.

It was, of course, recognized that this provision was at most a temporary expedient, the life of the pads was short and they were not effective in high concentrations; if a heavier charge of gas-absorbent were added the obstruction to breathing became serious. Moreover, they were only effective against chlorine gas, and once gas warfare had been established it was obvious that the enemy could and would use higher concentrations and different and more potent substances.

A research laboratory was therefore started in the Royal Army Medical College. The history of the evolution of our present protective apparatus records a story of untiring zeal, energy and dogged pluck not surpassed in the story of scientific research.

At the same time a research laboratory was organized in France and the closest liaison was maintained between workers at home and abroad. Every development in the use of gas was foreseen and provided for, so that our gas defence in a short time equalled and then surpassed that of the enemy.

A brief account of the various types of protection evolved will serve to illustrate the problems which must be met and solved in chemical warfare.

The original cotton-waste respirator was soon superseded by those of black veiling-cotton-waste impregnated with hypo. soda and glycerine. Two problems called for immediate solution:—

- (1) To make the filtering area greater; and
- (2) To make the absorbent substance such as would withstand not only chlorine but other gases which, it was recognized, might be used.

The filtering area was increased by substituting a helmet for a pad, thus providing an area of $3\frac{1}{2}$ to 4 square feet through which the air could enter and reducing the resistance to between 0.3 and 0.5 inch of water. The air current was also slowed so that the absorbent had more time to neutralize the noxious gas.

Suitable materials had to be found and in sufficient quantities. After a few days of testing on individuals a manometric device was devised for rapid testing at a definite standard pressure.

The colour of materials used in making helmets was also important, for if light colours were used men wearing the helmets would furnish an easy target for enemy fire.

The question of sight when wearing the helmet was also a knotty problem. At first mica windows were used, but these proved too brittle; non-flam cellulose acetate and chromicized gelatine were also unsuccessfully tried. Finally non-splintering triplex glass disks fixed in tin rims that clamped the textile of the helmet firmly by being screwed into flanged collars were adopted and proved most successful.

Polyvalency of the absorbent was first secured by adding sodium carbonate to the thiosulphate of soda and glycerol. This helmet could be donned in four to

six seconds, gave ten times as great protection as the pad, while its effective life against chlorine at a concentration of 1 in 1,000 was five hours. A new solution was made necessary by the fact that the absorbent afforded no protection against phosgene (carbonyl chloride) or hydrocyanic acid, and several other gases. An effective absorbent was, however, found after many trials in sodium phenate; but it was found that the solution rotted the woollen fabric of which the helmets were made. This difficulty was met by adopting a cotton material which took up more alkali, and for a double thickness of cotton gave a resistance of 0.2 to 0.3 inch of water, as against 0.5 inch for a single thickness of wool. The problem was further complicated by the discovery that the CO_2 given off in expiration neutralized the protective alkali, so that after a time it ceased to protect against HCN. It therefore became necessary to provide a valve through which the wearer could expire and so get rid of his CO_2 outside the helmet. The simple and effective respiratory valve still in use was the outcome of this research.

One more addition to the absorbent impregnating the helmet was made in January, 1916, i.e., hexamin—suggested by Russia—this substance removed the remaining phosgene (carbonyl chloride) which had escaped the sodium phenate.

With this final improvement the P.H. helmet, as it was called, removed 100 per cent of 1 in 1,000 phosgene and HCN. Of these helmets, from the first issue in July, 1915, until the final withdrawal in February, 1918, in favour of the box respirator as the sole issue, nearly 27,000,000 were made—many were supplied to our allies as well as to our own troops.

In addition to protection against lethal gases of the asphyxiant type, protection had to be afforded against a group of substances known as lachrymators whose chief action is on the eyes. The majority act in minute proportions so that as small a quantity as one part per million causes intense lachrymation which throws the victim out of action. These lachrymators were first used against us in the autumn of 1915, and the first protection against them sent to France was a goggle of rubber with glass eyepieces similar to motor goggles. This failed in many cases owing to the difficulty of obtaining close adjustment over the bridge of the nose. To obviate that trouble the French pattern was next adopted. This was of impervious cloth with flannelette lining and celluloid eyepieces, the fit over the bridge of the nose being obtained by malleable wire sewn into the lower edge of the fabric. These were found serviceable against low concentrations, but against higher concentrations the best fitting results were obtained with rubber sponge. In a final pattern the base was of stiff impervious fabric (gelatine formalin impregnation) lined with soft material to which were solutioned and sewn the two halves of an oval sponge—holes being cut in the sponge and the base into which were fitted screwed metal and glass (helmet) eyepieces. Elastics were provided for attachment.

The P.H. helmet was also fitted with rubber sponge round the eyepieces and was issued as the P.H.G. helmet.

Goggles were finally withdrawn after the issue of the box respirator, since they tempted a man to put on his goggles rather than his respirator, and so continue to inhale small quantities of gas which would have a cumulative effect.

No helmet could ever be completely polyvalent. For one thing it is impossible to impregnate so thin a layer of material with both oxidizing and reducing substances. The realization of this fact led to the research which culminated in

the production of the present box respirator. The object was to produce a container filled with strata of different absorbents through which air could be drawn—each group of noxious gases being removed or neutralized in its appropriate stratum. The box respirator was issued only one month before the enemy attacked with gases which the helmet could not have withstood.

Very extensive and exhaustive trials were made by Lieutenant-Colonel Harrison and his colleagues before a granule was made which was sufficiently active, and at the same time hard enough to withstand the shaking and general rough usage which the respirator must necessarily undergo and yet remain active.

The box respirator was originally charged with successive layers of: Sodium sulphite (reducing); soda-lime-manganate (neutralizing and oxidizing); animal charcoal (adsorbing and condensing); each layer being separated by plaques of cellulose. This was found to be completely polyvalent against every gas which the enemy had then used against us, and to give very slight resistance to respiration. It was efficient against carbonyl chloride for three hours, against chlorine for eight hours, and withstood a sequence of six gases run through it in succession, each for one hour. But it was found that gas tended to pass up the smooth interior against the side of the box so that this channel became ineffective, whilst the remainder of the box remained effective. This defect was remedied by corrugating the sides of the box and so lengthening this route, leaving large air spaces above and below the absorbent layers to equalize the flow and by arching the base of the lowest absorbent layer so as to divert the flow from the sides. Two valves were necessary—an inspiratory flap valve in the base of the box and an expiratory valve, like that in the helmet, between the mouthpiece and the box, so as to prevent expired CO_2 neutralizing the soda-lime-alkali. A closely-fitting facepiece with eyeglasses and nose-clips was added. The whole apparatus could be adjusted in twenty-five seconds (since reduced to ten seconds).

There were several slight modifications of the box respirator, and the small box respirator as at present in use replaced all other gas protection appliances in February, 1918.

Work is still being carried out on it to make it more perfect and to decrease its resistance to the passage of air to the lowest possible amount. The resistance of the present pattern is equivalent to about three inches of water.

The above sketch of the evolution of the methods of individual protection against lethal gases will show you the essentials to be aimed at in devising such apparatus:—

- (1) The apparatus must be capable of very rapid adjustment.
- (2) It must be able to neutralize all forms of noxious gases and clouds and vapours which may be used against the troops wearing it for a reasonable length of time.
- (3) It must offer as little resistance to breathing as possible so as to avoid diminution of the working powers of troops.
- (4) It must be strong and light.

The box respirator has, so far, resisted all gases used against us, but it will be readily understood that constant research in defensive measures must proceed *pari passu* with new discoveries of substances which may be used in chemical warfare.

The soldier must be taught that if his respirator is kept in good condition, and he has learnt to adjust it with the necessary quickness, he can place complete reliance upon it.

Very frequent inspection of respirators is necessary to see that they are in good condition. Periodical inspections are carried out by the anti-gas officer with the formation concerned, but it is the duty of all officers commanding units or sections of units to see that their men's gas equipment is thoroughly effective.

The most serious causes of damage to the respirator are: (1) Water entering the container and damaging the chemicals; (2) injury to the mask; (3) injury to one or both valves.

It is of the utmost importance in reference to (2) and (3) to see that nothing is carried in the satchel but the respirator and anti-dimming outfit for cleaning the eyepieces.

I hope to deal with the question of the disinfection of respirators in my last lecture.

The container, as finally issued, should be replaced after it has been breathed through for forty hours. A record card is therefore issued with each container, and on this should be entered the time during which the apparatus has been worn during cloud gas attacks or gas shell bombardments. The number of hours during which the respirator has been breathed through for training are entered in the bottom three rows under shell gas. The date of issue is also stamped on the card. A fresh card is issued with each container.

I have dealt above with the apparatus supplied for the protection of troops, and it is unnecessary to do more than remind you that in gas warfare everything depends upon the quickness and efficiency with which troops apply their protection. It is, therefore, necessary in preparation for war, to train all troops thoroughly in gas drill, i.e., in systems adopted for spreading gas alarms, in recognizing conditions whether of weather or environment when gas may be used, and in recognizing when gas shell is being used and the type, and in circulating information to all who may come into a gassed area. These are matters for the training ground rather than the lecture theatre.

In conclusion, therefore, I will refer briefly to the secondary means of protection against gas attacks.

(1) When cloud gas attacks were made, various methods were adopted to disperse the gas, e.g., firing and throwing bombs into the gas; lighting fires in the trenches. Fans were also supplied for removing gas from dugouts and trenches.

(2) Solutions of hyposulphite and hexamine with sprayers were also issued for spraying the air in trenches, dugouts, etc.

(3) With the development of gas warfare and the use of lethal gas shells these methods had to be revised, and additional measures taken for the protection of important dugouts, pill-boxes, aid posts, etc. It was recognized that if possible the dugout should be evacuated until the gas had dissipated, but short of this it was found that an effective measure was to light a fire in the middle of a dugout after a gas bombardment. It was necessary to take care that the ground outside the dugout was free from gas before the fire was lighted, otherwise the fire merely drew the gas into the dugout.

In the case of dugouts which could not be evacuated, e.g., aid posts, advanced

dressing stations, headquarters, a gas proof curtain was devised as a method of protection. One method of applying this curtain is as follows: A frame of four inches by one inch timber covered with blanket material is fixed flush with the wall, sloping outwards at an angle of 20° from the vertical. Anti-gas material, i.e., a special cloth to be treated with a solution of sodium thiosulphate and sodium carbonate in water, is cut to the required size, so that when fastened to the top of the frame it will close the entrance completely and leave about nine inches resting on the ground. Three pairs of laths are nailed horizontally to the curtain to keep it stretched. The lath on the underside must be left shorter than those in front so as to clear the frame. The lowest of the laths should be four inches from the ground but must not touch it. Two curtains should be provided, the upper as near the top of the staircase as possible (otherwise a pocket of gas may lodge and be carried into the dugout). The frame for the inner curtain should, if possible, slope inwards. A similar contrivance was used to protect pill-boxes.

When mustard gas came into use it became necessary to protect men handling objects contaminated with it and to find some means of removing it from clothing.

For men specially liable to contamination, e.g., gunners and stretcher bearers, in addition to their respirators, special gloves were provided. After trial of various substances leather gloves treated with unboiled linseed oil were found efficient. With them two pairs of cotton gloves were issued to be worn over the leather. Although efficient in preventing burns, these gloves were large and clumsy and hindered delicate manipulation.

To obviate the hardening of the leather with age the Americans adopted: (1) Gloves of a waterproof material coated inside with gelatine-glycerine-formalin composition and protected outside by another waterproof coating, and (2) gloves of a fabric coated with a softened layer of cellulose nitrate.

An effort was also made to provide clothing which would withstand mustard gas. We used cloth treated with boiled linseed oil, and the Americans cotton sheeting impregnated with boiled linseed oil, castor oil and paraffin wax.

These proved efficient but difficulties of transport and of readiness when wanted were great obstacles to their use.

To destroy mustard gas in clothing three methods were tried: (1) Treatment with steam or hot water; (2) treatment with chlorine gas; (3) exposure to fresh air.

As heavily contaminated or directly splashed clothing cannot be effectively cleaned without damage to the cloth it is considered that it should be buried.

Treatment with steam is the surest method of degassing contaminated clothing and this can be effectively carried out by means of Colonel Lelean's sack disinfecter, or in a plant of any delousing station.

The Americans found hot (not quite boiling) soapy water efficacious.

The French used water at 90°C . containing mild alkalis to neutralize the acid formed by hydrolysis of mustard gas.

A solution of washing soda is safe but it must be in correct proportions, too much or too little retards destruction of the mustard gas.

Keeping men whose clothing has been contaminated in a chamber containing one per cent chlorine for five minutes has been found effective. This treatment can be carried out with cylinders of chlorine gas in dug-outs.

For slight contamination exposure of clothing in open air for forty-eight hours suffices, but if the contamination is heavy or the weather cold, a much longer time is necessary.

Dug-outs may frequently be contaminated by infected mud brought in on boots. Washing with a stiff brush and water and sprinkling with chloride of lime have been recommended.

If dugouts are contaminated it is well to evacuate and destroy them. If this cannot be done the contaminated soil and beams should be removed, the walls and floor treated with chlorine, and the dugout shut up for twenty-four hours. After this period it should be well ventilated by placing a lighted brazier in it and shifting the position from time to time. The atmosphere may be slightly lachrymatory for some time, the chlorine masking the smell of mustard.

Chloride of lime may also be used for this purpose and for treating shell holes. In the latter case the lime should be covered with fresh earth, the latter being employed to prevent chlorine masking the smell of mustard and to render the hole less conspicuous. Two pounds of chloride of lime per square foot of surface gives excellent results, but this amount is prohibitive. One-half to one pound gives fair results.

In the time at our disposal it has only been possible to outline the chief points in measures of protection. Everything depends upon efficient preparation and training and in the impressing upon the troops that given these they may have every confidence that they will escape unscathed.

Current Literature.

Malaria.¹ *Epidemiology*.—Glynn and Matthews report a fatal case, in a girl aged 17, of malignant tertian contracted in the North of England. The case is remarkable as being the first example recorded in recent years in England of indigenous malignant tertian malaria and of fatal indigenous malaria. Commenting on this case, Blacklock comes to the conclusion that it was an acute primary attack, and that there was no evidence that infection was acquired by other means than a mosquito bite. The records of the incubation period and crescent formation render it probable that the girl was infected in a northern health resort, where anophelines are plentiful (*Anopheles maculipennis*, *A. bifurcatus*, *A. plumbeus*).

James states that during recent years the number of deaths in England registered as due to malaria contracted abroad has been usually between 50 and 60 per annum, but that in 1917 it rose to 126, in 1918 to 197, and in the first nine months of 1919 to 199, most of the deaths in 1918 and 1919 being among young men.

Brulé, May, and Lermoyez, who record a case of indigenous malignant tertian in a man aged 50, state that, though innumerable cases of indigenous benign tertian have occurred, only nine examples are on record in which the parasite of malignant tertian has been found in malaria contracted in France. In this number are included a mild case reported by Oettinger and Deguignand

¹ Reprinted from *Medical Science*, vol. 7, No. 2, November, 1921.

in a youth aged 18, who had spent his early life in Dordogne, a district free from marshes and where malaria is unknown, and a fatal case reported by Weil and Plichet. Both the cases had probably contracted the disease in Paris during the war.

Dupérié, who reports two cases of indigenous benign malaria in children at Bordeaux, points out that this town is particularly liable to the disease, soldiers repatriated from Salonica, foreign labourers engaged on the quays, and Spanish workmen forming a considerable contingent of carriers who only need a suitable anopheles to spread the infection.

Seyfarth had an opportunity of studying numerous cases of malaria at Gümürdshina, a small Turco-Bulgarian sea-coast town in Thrace, where the disease was so severe that from July 1 to December 31, 1917, 187 deaths were certified as due to malaria. The character of the disease was quite different from that usually described, so that the Turkish, Bulgarian, and German medical officers often mistook it for typhoid fever. Dysenteriform varieties of tropical malaria were frequently observed. Tenderness and pain in the appendix area often led to the erroneous diagnosis of appendicitis. A mixed infection of malignant tertian and typhus was very frequent and attended with a high mortality.

Hoskin gives the following statistics of 500 cases of malaria examined consecutively at the Ministry of Pensions. Three hundred and fifty-six had contracted the disease on the Salonica front, 62 in Egypt and Palestine, 45 in East Africa, and 37 in other theatres of war, including a few recurrences of fever contracted during service in India prior to 1914. Sixty-nine, or 16·4 per cent., had been discharged as permanently unfit, the highest percentage—28·9—of these discharges being among the cases contracted in East Africa. The average time spent in a malaria country before the soldier was transferred to a non-malarial theatre of war was considerably less in East Africa than that spent in Salonica and in Egypt and Palestine, probably owing to the length of the lines of communication, which was responsible for delay in bringing up supplies and establishing hospitals with adequate accommodation and necessary comforts.

Etiology.—According to Debuys, who records an illustrative case, the presence of carriers in a household is the probable explanation of the apparently unsuccessful treatment of those cases of malarial infection that do not respond to the proper use of quinine or of those that are proved to be cured, though the patients return with a supposed relapse which is in reality a reinfection. He records the case of a boy aged 6, brought to hospital with the complaint of having had fever for two months. Examination of the blood showed that he was infected with the æstivo-autumnal type of parasite. He was given quinine treatment and discharged as cured, but returned several days later with another attack. The other members of the household, consisting of two sisters and a brother, were then examined and found to be infected with the æstivo-autumnal type, though with the exception of an enlarged spleen they showed no evidence of the disease. They were all treated with quinine till their blood was sterile, and no further attacks took place.

Cases of transmission of malaria as the result of transfusion of blood have recently been reported by Oehlecker, of Hamburg, and van Dijk, of Rotterdam, respectively. Oehlecker's patient was a woman, aged 55, who was transfused for severe anæmia secondary to an operation for nasal polypi, the donor being her son, a vigorous man of 29, who had formerly been in the tropics (West Africa), but had never had an attack of fever. Fourteen days after the transfusion the woman developed an attack of double tertian, ring forms being found in her blood. In the case of the donor a violent shivering attack developed thirty-six hours after the transfusion, so that the removal of a large quantity of blood (one litre), had a provocative effect. No parasites were found in his blood,

but the examination was not made until three weeks after his attack. Van Dijk's patient was a nursing sister in a Rotterdam hospital, suffering from a severe attack of influenza whom he transfused with the blood of another sister convalescent from the disease. Three weeks later the patient developed a typical attack of tertian malaria, although she had never had a previous attack and there was no other case of malaria in Rotterdam. It was then found that the donor had had an attack of malaria seven months previously and malarial parasites were found in her blood.

Symptomatology.—From a study of the *time incidence* of a thousand simple tertian malaria paroxysms, Stephens, Yorke, Blacklock, and Macfie concluded that ninety per cent of the paroxysms in simple tertian malaria occur during the hours of activity, i.e., 7 a.m. to 6.59 p.m. The maximum number of paroxysms occurred at 2 p.m. Alteration of the period of activity by one hour, the result of the adoption of summer time, produced a corresponding alteration in the time of incidence of the paroxysms.

Hajira records five cases of a *hæmorrhagic type of malaria* characterized by the following symptoms: frequent liquid hæmorrhagic stools in large quantities, containing shreds of mucous membrane but no faecal matter, bilious vomiting sometimes associated with hæmatemesis and hæmaturia, clammy extremities, and an almost imperceptible pulse. In three cases examination of the blood showed the malignant tertian parasite and in one a mixed infection; the other two cases were clinical malaria with an enlarged spleen. All the cases recovered under treatment by intramuscular injections of quinine, subcutaneous injections of pituitrin, and calcium chloride internally.

Fróes, of the Bahia Faculty of Medicine, reports a case of simple *quartan malaria* in a negress, aged 20, which appeared in the form of urticaria of two days' duration followed by an interval of two days in which she was free from the eruption. Examination of the patient showed tenderness of the liver, slight enlargement of the spleen on percussion, and the presence of *Plasmodium malarie* in the blood. The condition was cured by quinine.

Simons, of Dusseldorf, records a case of quartan fever remarkable for the fact that the small number of parasites was in striking disproportion to the severity of the symptoms. The cold stage, which generally lasts half an hour to two hours, was limited to a few minutes. The hot stage, which on the average lasts from four to eight hours, lasted only one or two hours, and was accompanied by an extraordinarily severe attack of sweating. While the duration of the whole attack in mild cases is normally from six to twelve hours, in this case very severe attacks in which the temperature rose on four occasions to 107.6° F., and once to 110.2° F., lasted from a quarter to half an hour. Quartan fever being usually a mild disorder, Simons considers that the course of the disease, the severity of the attacks, and the powerlessness of treatment render the case unique in the literature of malaria.

According to Massari, who records a case in a man, aged 23, most of the reported cases of *rupture of the spleen* in malaria have been discovered only at the autopsy. In some districts of India malarial rupture of the spleen is so frequent that Crawford found 477 examples among 3,884 autopsies, or 4.45 per cent. On the other hand, reports of cases in which an operation has been performed are extremely rare, this being due to the circumstances of life in the tropics, and the superstition and indolence of the natives. Noland and Watson (1913), who, during the construction of the Panama Canal, operated on three cases of rupture of the spleen among 23,000 malarial patients, state that the patients were able to continue their work for a certain time after the rupture had taken place. In addition to his own case, in which operation was successful, Massari has collected 20 other cases of operation for rupture of the malarial spleen, 14 of which recovered and 6 died. The prognosis depends on the rapidity with

which the operation is performed. Owing to the large number of cases of malaria resulting from the war the possibility of rupture of the spleen following a slight injury should always be borne in mind. Malarial patients and their friends should therefore be warned as to the vulnerability of the spleen, and instructions should be issued to first aid posts, police stations, etc., so that surgical assistance may be obtained without delay.

According to Hennesey, who has observed 17 cases of rupture of the spleen, in only 2 of which the organ was of normal size, the rest weighing from 10 to 37 ounces, 151 cases of rupture of the spleen were officially recorded for the four Federated Malay States during the four years 1915-19, this high figure being indirectly due to malaria. The greater liability of the malarial spleen to rupture is shown by the fact that during the years 1900 to 1909, the number of cases of rupture of the spleen recorded for the State of Selangor was only six, whereas from 1909 to 1919, owing to a great influx of labour into the country and a great increase of malarial fever, a corresponding increase in the number of cases was recorded, viz., fifty-three cases.

Jebens remarks that in many cases of latent malaria changes take place in the *liver and pancreas* indicated by urobilinuria, enlargement of the liver, and glycosuria, which it is difficult to explain until the cause is revealed by provocative measures, such as the quartz lamp or adrenalin, when malarial parasites are found in the blood. As soon as the nature of the condition is recognized and quinine has been administered, the symptoms subside. But if for any reason the malaria is not cured, repressive changes may succeed the initial hyperæmia in the liver, and cirrhosis supervene. In like manner glycosuria may be converted into diabetes mellitus when a condition of protracted and relapsing malaria persists, giving rise to gross organic changes possibly in the islands of Langerhans. Jebens alluded to a case reported by Jacobson in which fatal diabetic coma developed a week after the last attack of malaria. Burdel has also recorded cases in which after repeated relapses glycosuria became permanent and independent of the attacks of malaria.

Furno refers to the papers of Fraga, Dudgeon and Clarke and others on involvement of the *suprarenals* in malaria, and records a case in a man, aged 42, who about six months after his first attack of malignant tertian developed all the signs of Addison's disease, such as adynamia, fall of blood-pressure, and pigmentation of the skin and mucous membranes. Suprarenal opotherapy was followed by considerable improvement, and the patient was able to resume his hard work as a porter. The patient was a vigorous man without any family or personal history of tuberculosis, and careful examination of the chest, including the use of X-rays, failed to reveal any signs of tuberculosis. Furno therefore concludes that the syndrome of Addison's disease in this case was due to malaria.

Parsons draws attention to the *peritoneal syndrome* in malaria which is characterized by general abdominal pain and tenderness, some distension and muscular spasm. In some cases these signs are distinctly localized, the right side showing marked rigidity as compared with the left, or the upper right quadrant may be involved, simulating a gall bladder infection. Parsons suggests that the symptoms are due to extension of the perisplenitis to the diaphragm. The claim that the symptoms are of an inflammatory nature is supported by the presence of leucocytosis.

In the course of two months Enright saw ten cases of malaria, chiefly of the subtertian variety, in which the onset was accompanied by *ascites*, œdema of the feet, puffiness of the face, frequency of micturition, and vague discomfort over the lumbar regions. All responded readily to quinine. No specimen of urine contained casts, but there was invariably a very appreciable amount of albumin which quickly disappeared after quinine treatment.

Coullard-Descos suggests that the occurrence of *œdema* without albuminuria

in the course of malaria is possibly due to changes in the thyroid gland like the oedema met with in cachexia strumipriva.

Coda, of the Turin University Medical Clinic, records two cases of malaria in men, aged 42 and 56 respectively, presenting the blood picture and all the other manifestations of *pernicious anemia*, including *achylia gastrica*, in whom complete recovery took place under quinine treatment.

Fonzo reports two cases of *musculospiral paralysis* of malarial origin in children. In one case the paralysis developed during an attack of benign tertian, and in the other case about a month after an attack of malignant tertian. All other causes for the paralysis but malaria could be excluded in both cases.

Sabatucci records two cases in soldiers who, after contracting malaria in Albania, began to suffer from paræsthesia and weakness in the lower limbs. Intermittent claudication then developed, and finally complete *paraplegia*, bed-sores, and trophic ulcers. There was a loss of all modes of sensibility, which was most marked in the distal segments and less in the proximal ones. The paraplegia, which was at first flaccid, later became spastic and under vigorous quinine treatment gradually improved until only a slight paraparesis remained in one case, while in the other the symptoms were a little more pronounced. The condition is attributed by Sabatucci to spinal softening due to malarial arteritis in the lower part of the dorsal cord and some of the lumbar segments.

According to Porot, of Lyons, who refers to the recent work on *malarial meningitis* (*vide Medical Science*, 1919, i, 59, 60), primary malaria may sometimes assume the form of acute meningitis with continued fever in children or young subjects, but a meningeal reaction is common during a relapse. The symptoms may be intermittent like the fever, attacks of nuchal rigidity, vomiting, and dissociation of the pulse and temperature occurring every two days, but as a rule the meningitis is the result of several attacks of malaria. The patient is sunk in a meningeal coma which is curable or fatal according to the case and the rapidity with which treatment is applied. Lastly malarial meningitis, like all other forms of acute meningitis, may have sequelæ such as pain of radicular distribution, muscular atrophy, and ankle clonus.

Marinesco records a fatal case of myoclonic *encephalomyelitis* in a woman, aged 26, in whom the clinical appearances and the slight degree of spinal lymphocytosis suggested the diagnosis of epidemic encephalitis. The malarial origin of the condition, however, was shown by examination of the blood and the characteristic changes in the central nervous system.

Conti reports the case of a female child, aged 1½ years, admitted to hospital with acute nephritis, who developed left *hemiplegia* the day before death. The autopsy showed a large hæmorrhage in the right cerebral hemisphere and degeneration of the vessel walls on microscopical examination. The hæmorrhage was attributed by Conti to a chronic nephritis of malarial origin.

Constantinesco, of Bucharest, records five cases in soldiers who presented a *cerebello-spastic syndrome* characterized by disturbance of equilibrium, asynergy, adiadokokinesis, nystagmus, dysarthria, exaggeration of the reflexes, and ankle clonus. The symptoms were undoubtedly due to malaria for the following reasons: (1) They appeared after definite attacks of malarial fever; (2) examination of the blood always showed *P. præcox*; (3) quinine caused the symptoms to disappear.

(To be continued.)

Reviews.

THE DIARY OF A YEOMANRY MEDICAL OFFICER: EGYPT, GALLIPOLI, PALESTINE AND ITALY. By Captain O. Teichman, D.S.O., M.C. Published by T. Fisher Unwin, Ltd. Pp. 282. Price 12s. 6d. net.

To a Regimental Medical Officer who served in Egypt, Gallipoli and Palestine the above work has proved of the greatest interest. The author tells his story in a free and easy manner; considering the difficulties of keeping a diary on Active Service, he has accumulated a wonderful amount of interesting detail both military and medical.

From the many episodes that I personally witnessed or took part in I can vouch for the accuracy of his statements.

Every Medical Officer should read this work and learn what can be done for the care and comfort of troops by a keen and thoughtful Regimental Medical Officer.

I wish rather that the author had told us more about the doings and sayings of the men he served with and knew so well and by whom he was so universally liked. He must have many a good story on those odd scraps of paper.

L. A.

A TEXTBOOK OF GENERAL PATHOLOGY. By Beattie and Dickson. London: W. Heinemann, 1921. Second Edition. Pp. xiv + 496. Price 31s. 6d. net.

The appearance of a second edition of this well-known textbook of General Pathology, which had already established its popularity, is to be welcomed. No fundamental alteration in the general arrangement of the book has been made in the new edition, the changes being chiefly those necessary to cover the advances made in various branches of the subject during recent years. This has necessitated the complete revision of certain chapters.

The section dealing with animal parasites has been re-written, thereby ensuring an accurate account of our present knowledge of an increasingly important branch of pathology.

The extensive research undertaken on the subject of inflammation has been described in a chapter which gives a clear and comprehensive outline of the changes occurring in inflammatory and infective conditions of special tissues. This subject is illustrated by unique and very well reproduced plates and diagrams.

As the book does not presume to be a textbook of bacteriology, the subject of immunity has been limited to a concise résumé of our knowledge of the problems involved in this subject.

The book is well illustrated, almost entirely by photomicrographs and coloured plates, to the excellence of which a measure of praise must be awarded, but we must confess that the printer's reproductions in the first edition were much superior to those of the present edition.

The book can be heartily recommended as an excellent exposition of present knowledge to the student of general pathology.

H. M. P.

THE WASSERMANN TEST. By Charles F. Craig, M.D., M.A., F.R.C.S. London: H. Kimpton, 1921. Second Edition. Pp. 279. Price 25s. net.

In nine chapters the historical, pathological and clinical aspects of the Wassermann test are dealt with in detail. The tenth and final chapter is devoted to the test upon the cerebrospinal fluid, the colloidal gold test and the cell count and tests for increase in globulins in the cerebrospinal fluid.

Much of the book is taken up with a description of the preparation and titration of reagents and of the modification of the test itself as these have been devised by the author. These methods are now authorized for use in the United States Public Health Service, and in the Army Medical Service. As is well known, they differ in many respects from those usually employed in this country, and to British readers the book will appeal, therefore, in respect to technique, more as a clear and concise exposition of what is being done elsewhere than as a laboratory guide.

The author uses human blood corpuscles in his hæmolytic system. Since the publication of the first edition, the importance has been demonstrated of selecting donors for the blood-cell suspension from individuals belonging to Group IV of the Moss classification, and the technique in connexion with this is described in detail.

A chapter on factors which, according to the author, influence the result of the test is of particular interest and importance. Such questions are discussed as the effect on the reaction of ingestion of alcohol, by which a positive Wassermann reaction may, it is said, be rendered negative, and the influence of microbial infection of the specimen, which, it is stated, may, in the case of certain bacteria, cause inhibition of lysis without betraying its presence in the serum control tube.

The effect upon the test of minute quantities of chemicals on the glassware are also dealt with.

This book first appeared in 1918. In this, the second edition, much has been re-written and elaborated. As a suggestive and informative work it can be strongly recommended to anyone engaged in the branch of serology to which it is devoted. There is a useful bibliography.

SYPHILIS AND VENEREAL DISEASES. By C. F. Marshall and E. G. Ffrench. London: Baillière, Tindall and Cox, 1921. Fourth Edition. Pp. xi + 443.

In producing a book of this kind which is intended for the guidance of students and practitioners, the authors are faced with the difficulty of presenting a vast subject within reasonable limits with a due sense of proportion for its various sections. Though, on the whole, a sound general idea is given of the venereal diseases, we cannot say that this problem has been entirely overcome in the work under review. The attempt has been made to compress too much information within the limits of a book of this size with the result that some of the subject matter has had to be unduly abbreviated.

The subject of the cultivation of the gonococcus, for example, is dismissed in a few paragraphs, and the information given would be of little assistance to anyone attempting to carry out this procedure. Again, there is a very brief description of Jensen's modification of Gram's stain which has now largely superseded Gram's method.

Also a very condensed description of the Wassermann test is given, and we should have preferred to see cited one of the methods which have received the approval of the Medical Research Council, and which are now in very general use in this country.

Whilst the book is liberally illustrated, we think that at any rate one of the illustrations, namely, that purporting to show condylomata of the anus is not at all typical of this common condition, while the drawings of no less than four different urethrosopes might with advantage have been omitted. These latter convey very little to the uninstructed reader for whom the book is written. Moreover, urethroscopy is an art in itself and which cannot be adequately discussed in the necessarily short description which accompanies the drawing.

In a section dealing with the diagnosis of syphilis the authors utter a warning against "the dangerous tendency at the present day to exalt the value of laboratory diagnosis and neglect that of clinical experience. A diagnosis based upon laboratory tests alone may lead to disastrous consequences both to the patient and the practitioner." But it is undoubtedly also true that the necessarily superficial knowledge of many clinicians in regard to the complement fixation test for syphilis has engendered in some quarters a certain unmerited scepticism in regard to the usefulness of the test.

In discussing the relationship of syphilis and yaws, it would appear to be stated, apparently as an argument in favour of the identity of the two diseases, that many cases of yaws in the West Indies and India seen by one of the authors

were cured by two doses of salvarsan. Reasoning of this kind, especially when adduced for the consumption of students is to be deprecated. It is hardly necessary to point out that this treatment has also been used with success in relapsing fever, but the disease is not for this reason identical with syphilis.

Certain errors, such as the statement on page 23, that "bacteria have no flagella," and on page 330 that "agar is conglutated" below 36° C., will doubtless be eliminated in future editions.

THE SPLEEN AND SOME OF ITS DISEASES. By Sir Berkeley Moynihan. Bristol: J. Wright and Sons, 1921. Pp. x + 129. Price 21s. net.

Sir Berkeley Moynihan's Bradshaw Lecture on diseases of the spleen was based upon material of which the present book is the enlarged expression.

It is tempting to take this delightful work chapter by chapter and indicate the immense mass of research which the author has condensed and epitomized for us, but this would occupy space far beyond the limits of the present review. Let it suffice to mention a few of the many suggestive theses laid down by the author:—

(1) In dealing with the anatomy of the spleen stress is laid upon the order in which the veins from the pancreas, containing the secretions set free by the islets of Langerhans, from the hind gut and from the fore gut, bearing the products of digestion, sugar and the amino-acids of digestion, etc., enter the splenic vein. The mutual interaction of these different blood-streams must be of high importance to the liver, through which every drop of this blood must pass.

(2) In the Introduction, in the body of the book and in the conclusion, it is pointed out that the spleen is only one organ of a system, and in a case of splenic disease inquiry should be directed to the determination of the functional capacity of all the various organs likely to be deranged.

(3) The book is illustrated by diagrams showing first the normal relations of spleen, liver and bone marrow cells, and then the changes introduced by disease. There is also in the chapter on the relations of liver and spleen, a scheme showing the blood channels, cell masses and gall ducts in the liver from an entirely new point of view to that usually described in works on Histology.

(4) Writing of the various types of cirrheses of the liver, the author shows good reasons for concluding that they are pathological variants of a single type and due to connective tissue laid down in certain parts of the liver in defensive response to irritation.

The above are merely a few points of interest selected at random from a book which abounds in them.

There is still an immense amount to be learnt about the functions of the spleen and the great value of the present work is the prompting suggestiveness with which it points out untrodden paths and fascinating terra incognita. It is good for inquiring youth that a great scientific imagination should occasionally point out the unknown land from the Pisgah of its own eminence. Our generation may not know for certain whether (for example) the spleen is concerned in the activation of digestive ferments but while we have the inspiration of teachers like Moynihan there is good hope that our grandsons may know.

SYMPTOMATOLOGY, PSYCHOGNOSIS AND DIAGNOSIS OF PSYCHOPATHIC DISEASES. By Boris Sidis, A.M., Ph.D., M.D. Edinburgh: E. and S. Livingstone, 1921. Pp. xix + 448. Price 21s. net.

This book deals with some of the fundamental principles of a modern view of of psychopathology and of the subconscious. It is divided into three parts. Part I deals with the question of subconscious states and their investigation by means of hypnoidal and hypnotic states.

The hypnoidal twilight state of Sidis is a drowsy condition analogous to the primitive rest state of lower animals; it can usually be simply and safely induced in the human subject and has advantage over the hypnotic state for some investiga-

tions. Part II deals with psychopathic diseases, and the nature of hallucinations, illusions, delusions and other mental derangements is discussed in a practical manner. In Part III diagnostic and "psychognostic" methods are described. By psychognosis is meant a broad general appreciation of a patient's mental make-up which is only to be gained by close association and companionship both in work and play.

The author's views are very rational. He strongly holds that the phenomena of functional mental disorders have no significance in the present, such as is attributed to them by the psychoanalytic school. On the contrary they are purely pathological and useless. The bizarre symbolism which that school reads into such phenomena are condemned as senseless and utterly erroneous.

The book does much to substantiate the author's claim that psychopathology must not be neglected by the student of general medicine. H. G.

MEDICAL HISTORY OF THE WAR.

The first volume of the Official Medical History of the War has now been completed by Major-General Sir W. G. Macpherson, K.C.M.G., C.B., LL.D. The series, of which Sir William Macpherson is Editor-in-Chief, is so planned as eventually to comprise 12 volumes: General History of the Medical Services (4 volumes); Diseases of the War and the Medical Aspect of Aviation and Gas Warfare (2 volumes); Surgery of the War (2 volumes); Hygiene of the War (2 volumes); Pathology and Medical Research during the War (1 volume); Medical Statistics and Epidemiology of the War (1 volume).

The main object in preparing a consecutive history of the Great War is to present in an accessible form the material buried in masses of war diaries, administrative files, official reports and other documents, before they have been stowed away and their existence forgotten except by a few. The first volume is a record in narrative form of the medical services in the United Kingdom and in garrisons overseas, with an account of the medical services in the operations against the German colonies in West and South-West Africa and in Tsingtan. The feature which stands out most prominently in the history, says Major-General Macpherson, is "the magnificent and harmonious co-operation afforded by the medical profession throughout the Empire, and by a host of voluntary and other helpers in the work of the Army Medical Service and the Royal Army Medical Corps."

Including labour units, provision had to be made at one time or another for the medical services of forces with a total strength of nearly 3,500,000 operating in every variety of country and climate. A total maximum of 637,746 hospital beds were maintained in the United Kingdom and in theatres of war, and some 770 medical units of all kinds were mobilized and dispatched to expeditionary forces. In addition 75 hospital ships or ambulance transports were equipped and administered by medical services in the United Kingdom, and 2,655,025 sick and wounded were brought to its shores for further treatment and disposal between August, 1914 and August, 1920. The personnel for medical services numbered at the time of the Armistice 144,514 officers and other ranks, most of whom joined the Royal Army Medical Corps and were trained in the United Kingdom.

As regards the operations in South West Africa it is interesting to compare the mortality rates through enteric fever with those in the South African Campaign, 1899-1902, and the German-Herrero Campaign, 1904-7. In the South African War the death ratio per 1,000 average strength for the whole period, 1899-1902, was 38.8, the annual ratio being 14.7. In the German-Herrero Campaign the ratios were 46.5 and 16.3 respectively; while in the South West African Campaign, 1914-15, the ratios were 0.78 and 0.75 respectively. It will be seen, too, that in the operations in the Cameroons the number of deaths from disease compared with the number killed in action exhibits a great advance in the efficiency of the Army Medical Services, for whereas in the South African War

the deaths from disease numbered nearly twenty-fold the number killed, in the Cameroons the numbers were approximately equal. The volume will shortly be available through any bookseller at the price of £1 1s.

Correspondence.

HÆMATOPHAGY IN TYPHUS FEVER.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—May I be allowed to add one further point bearing upon this question in relation to typhus? I had noted the same, but omitted to mention it.

Stevenson and Balfour, in the paper to which reference was made, cite an observation by Fical, which provides, I think, a significant indication. Fical found (in cases of typhus) round bodies, whose nature he was not able to determine, occurring in the cytoplasm of large nerve-cells of the cerebral cortex and elsewhere in the brain, and also both outside and inside the capillaries. These bodies varied in size, the larger being about 6μ to 8μ in diameter (i.e., approximately the size of a red corpuscle), and these sometimes contained secondary bodies. Occasionally, very large forms were encountered, 12μ to 16μ , which resembled, the author states, Negri-bodies.

This observation seems to me to point definitely to the occurrence in typhus of hæmatophagy and blood alteration of an abnormal character; in addition to the exercise of this mode of behaviour, along more normal lines, by the endothelial cells. It is quite possible that, while the essential and "specific" reaction to the virus (*resp.* the ferment-virus) occurs in cells of endothelial type, certain other tissue-cells also may thereby be stimulated to hæmatophagy and attempted, but unsuccessful blood-digestion (secondarily, and on a small scale). Needless to say, such behaviour does not necessarily imply hydrophobia! It is interesting to note that Fical refers particularly to a different situation of the bodies in the nervous tissue, i.e., in cells of the cerebral cortex—not in cells of the *hippocampus* and *cornu ammonis*. Again, the ferment would be different; and the bodies themselves probably chemically, if not slightly morphologically, different also. But Fical's observation does signify, I think, that bodies comparable to Negri-bodies, resulting from hæmatophagy by nerve-cells, may occur as well in hæmatophagic diseases other than hydrophobia, e.g., in typhus.

I am, Sir, &c.,

H. M. WOODCOCK.

APPRECIATION OF MAJOR-GENERAL SIR GEORGE EVATT, K.C.B.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

DEAR SIR,—I noticed that there was no mention of General Evatt's son in the appreciation published in last number of the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS. The same omission occurred in the notice of his career in the *British Medical Journal*.

His son, who was a Captain in the Middlesex Regiment, was killed in France in the early part of the war. This was a great blow to Evatt, who was deeply attached to his son and very proud of him. The boy was, I believe, very popular in his regiment and with all who knew him. The effect of his death on General Evatt's health was very great, and he never seemed to recover his old spirit and energy from that time.

Creek End,

Shepperton.

December 21, 1921.

I am, etc.,

W. DONOVAN, Major-General.

On page 463, December number, the article by Major W. E. Home on "Malaria and Urobilinuria," in paragraph 7, read on August 1 instead of on August 8.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

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A HOLOTRICHOUS CILIATE PATHOGENIC TO *THEOBALDIA*
ANNULATA SCHRANK.

BY BREVET LIEUTENANT-COLONEL W. P. MACARTHUR.

Royal Army Medical Corps.
Army School of Hygiene.

INTRODUCTORY.

ON October 11, 1921, a supply of mosquito larvæ for class work in the Army School of Hygiene was obtained from a field dyke three miles north-east of Blackpool. On examination I found the catch comprised, in approximate numbers, 100 *Anopheles bifurcatus* Linnæus, in the second and third instar; 30 pupæ and larvæ of *Theobaldia annulata* Schrank, mostly fourth instar with a few third; and 12 pupæ and fourth instar larvæ of *Culex pipiens* L. As the determination of the instar in a struggling larva is usually a lengthy affair, each larva was not examined individually. I contented myself with selecting several specimens representative of each size present and determined the instar of these.

Adult mosquitoes being most required, the pupæ and larvæ of all varieties were kept together in a large vessel of the original water, aerated from time to time, and a number of imagines of *T. annulata* and *C. pipiens* was obtained. During this period the laboratory sergeant found 1 of the *Theobaldia* larvæ dead, and in accordance with custom he removed it for clearing and mounting. On the morning of October 20 I carefully looked over the larvæ in the vessel, and satisfied myself that all were alive; there were then about 15 *Theobaldia* larvæ left. About an hour later I noticed that 1 had died in the interval, and removed it for examination. It was a *T. annulata* in the fourth instar, and under a low power of the microscope I was surprised to see that the eye pigment had entirely disappeared. On looking more closely I saw that the interior

of its head was swarming with ciliates, over 200 being present; the parasites were packed so tightly in each antenna that individual movement was impossible, and only an occasional undulation passed along the mass. Those in the cavity of the head were swimming about freely and actively; the thorax, abdomen and siphon were similarly infected; the gills were free. Altogether the larva contained from 600 to 800 ciliates, and none could be found in the water from which the larva was taken. Next day another *Theobaldia* larva died, and was found to be similarly parasitised; the eyes of this also had been destroyed. I then heard for the first time of the larva which the serjeant had found dead, and which had reached oil of cloves the previous day. Examination showed this larva to have been infected also, but the parasites were much degenerated owing to non-fixation.

On October 23, a second batch of larvæ was obtained from the same dyke, and consisted of 96 *A. bifurcatus* in the second and third instar, and 57 *T. annulata* mainly third and fourth, with an occasional second, instar. These were kept separate from the first batch, but treated in the same manner, and subsequently proved to be infected also.

Both batches of larvæ were watched closely for further cases of infection, living larvæ being examined microscopically from time to time, particular attention being paid to any which seemed sluggish or otherwise abnormal, and an occasional larva was dissected and examined for parasites.

Microscopical examination cannot be relied on to detect a light infection, especially in a living larva.

Two *Theobaldia* pupæ of the original batch died on November 7. These were also infected, but to a much less degree than the larvæ, which presumably explains their reaching the pupal stage. The chitinous tubes within which the legs form contained ciliates, which were also present inside the abdomen of one imago. This precludes any possibility of a post-mortem invasion, apart from the fact that the exo-skeleton was quite undamaged and that the pupæ were only recently dead. One, indeed, had been dead only a few minutes; it came to the surface and straightened itself out and I watched to see the imago emerge; but all movement ceased, and on examination of the pupa I found it was dead and in the condition described.

Subsequently infected larvæ and pupæ were found as follows:—

One (4th instar)	November 7
Five (one 2nd, three 3rd and one 4th, instar)	" 8
One (2nd instar)	" 13
Two (3rd and 4th instar)	" 15
Two (4th instar)	" 27
One (4th instar)	" 30
One pupa	December 1
One pupa	" 2
Two (4th instar)	" 11
One (4th instar)	" 13
One (4th instar)	" 14

Altogether 22 *T. annulata* were found parasitised; 2 of these were alive when detected but died later; 18 were recently dead and undamaged, and 2 had been dead for several days when discovered. For some reason, these 2 died at the bottom of the vessel amongst débris, and were not noticed at the time; the others died on the surface and were quickly detected as the larvæ were kept under close observation and examined several times daily.

The destruction of the eyes already mentioned was a constant feature in the infected larvæ, and this was so foreign to my experience of larval disease that an examination of the eye condition constituted the first test of suspected infection, and in no case did a larva with normal eyes prove to be parasitised on further investigation. In one case the ciliates were watched attacking the eyes and were surrounded by whirling clouds of pigment kept in motion by their cilia.

It will be observed that the 22 cases of infection were confined to *T. annulata*, the other mosquito larvæ (*A. bifurcatus* and *C. pipiens*) remaining free from invasion by ciliates although kept in the same vessel as the *Theobaldia*. Several larvæ died of fungus infection, and several, as larvæ do, from no obvious cause, but none of these was found parasitised, either on preliminary examination, or on subsequent dissection which was always performed. *Chironomus* larvæ, and a number of crustacians were also dissected but no sign of infection could be discovered.

None of these ciliates was found at any time otherwise than in association with infected larvæ and pupæ; an undamaged and recently dead larva might contain 1,000 ciliates but none was ever discovered on examining several watch-glassfuls of the water from which the larva had been removed.

METHODS OF EXAMINATION.

The parasites were examined after fixation and staining: by *intra vitam* staining; and unstained. In each method, preparations were made showing the ciliates *in situ*, and also after liberation. The larva from which figs. 1, 4 and 5 were drawn was fixed for twenty minutes in Schaudinn's solution containing five per cent of acetic acid, passed through iodine alcohol into distilled water, stained in Meyer's hæmalum for forty-five minutes and differentiated in one per cent HCl in thirty per cent spirit. After being well washed in tap water the larva was passed through the graded alcohols into oil of cloves and kept there until well cleared, controlling this by frequent examinations under the $\frac{1}{4}$ inch objective.

After a day in xylol the specimen was mounted in Canada balsam, some parts whole, others being carefully teased out in the balsam to liberate the contained parasites.

Some larvæ were stained entire, or in parts, by iron hæmatoxylin, which gave a good picture, and other methods of staining and fixation were used with more or less satisfactory results. *Intra vitam* staining

with neutral red and hæmatoxylin gave beautiful effects, and if the dilution was sufficiently high the ciliates remained active and could be studied for hours.

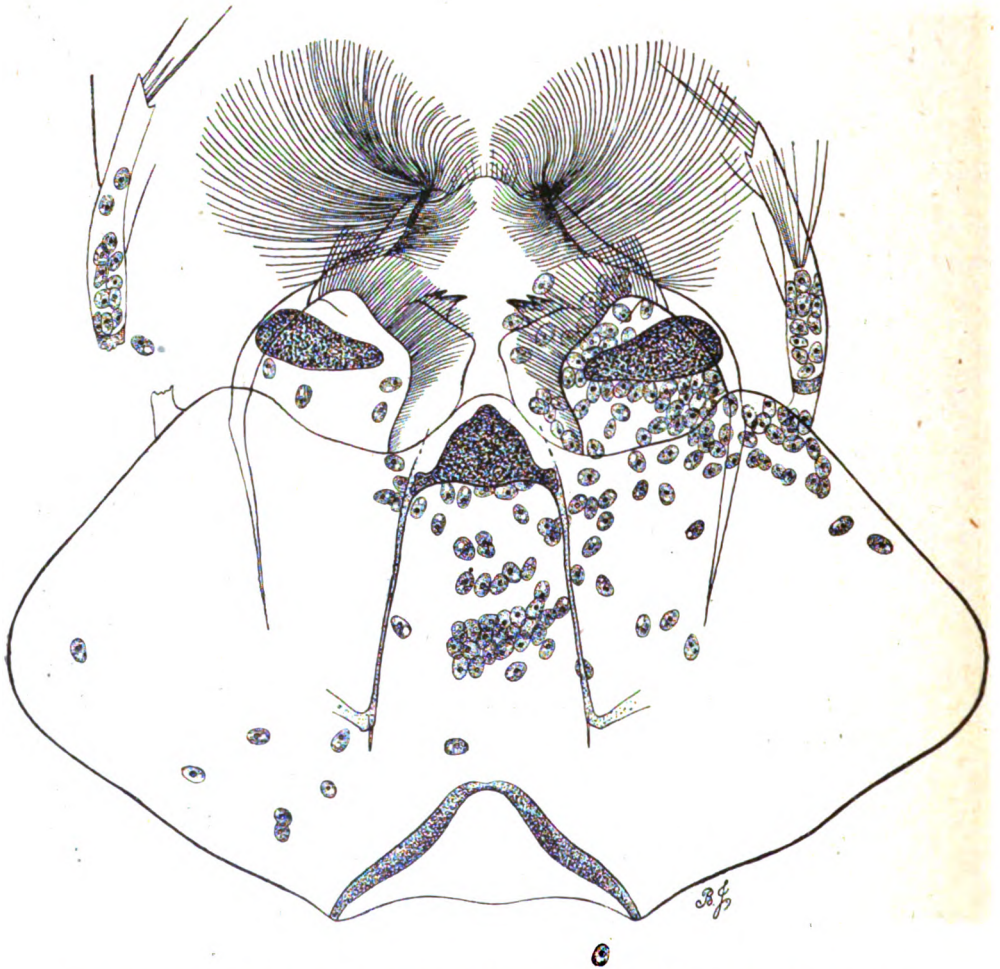


FIG. 1.—Head of infected larva of *Theobaldia annulata* Schrank (post-antennal hairs, and some other details, omitted). $\times 120$.

DESCRIPTION OF THE PARASITE.

A holotrichous ciliate of the suborder Hymenostomata, so far only found in the blood of *T. annulata*. The body varies in shape from elongate oval to broad oval, and is longitudinally striated. There is much difference in size, but most of the forms seen vary in length from 25 to 40 μ , the longest I found being 57 μ . The maximum breadth of well-grown individuals usually lies between 15 and 25 μ . The smallest forms measure 8 or 9 μ in length, and every stage in size between these and the mature

ciliates may on occasion be seen. Considerable variations in shape are noticed; the rapidly swimming forms are relatively long and narrow, and are concave ventrally and convex dorsally; the more slowly moving individuals are relatively shorter and broader, and more or less barrel-shaped.

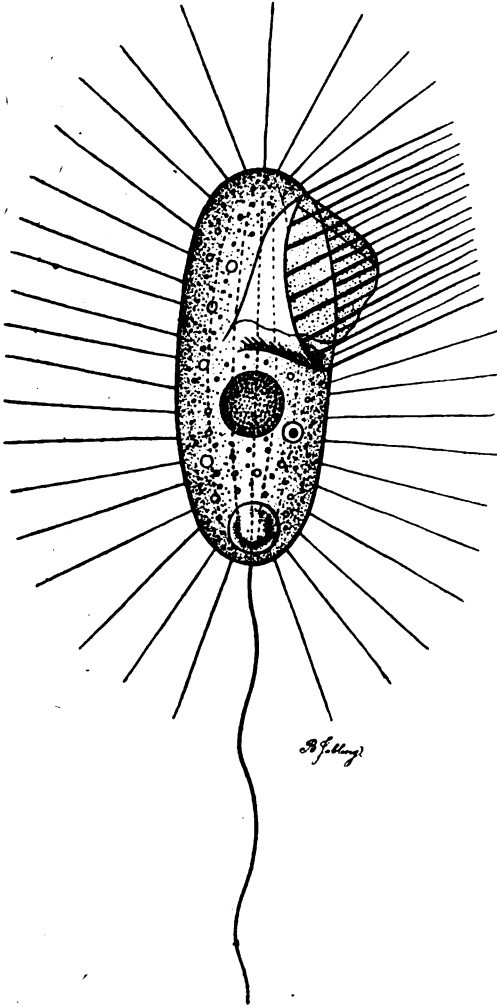


FIG. 2.—A small form ($= 25 \mu$) unstained, with long caudal cilium. In some individuals the cytostome is considerably longer than shown here.

When enclosed in a restricted space where movement is difficult they progress by slow, flowing movements, suggesting those of an amoeba, the contour of the body conforming to the surroundings; in squeezing past some obstruction, the creature throws out a clear projection of ecto-

plasm into which the glandular endoplasm flows as the obstruction is passed. Such an individual when freed assumes at once its ordinary shape. The smaller individuals show a long caudal cilium; this tail-like structure is present but much shorter in the forms intermediate in size; and is absent in the largest ciliates.

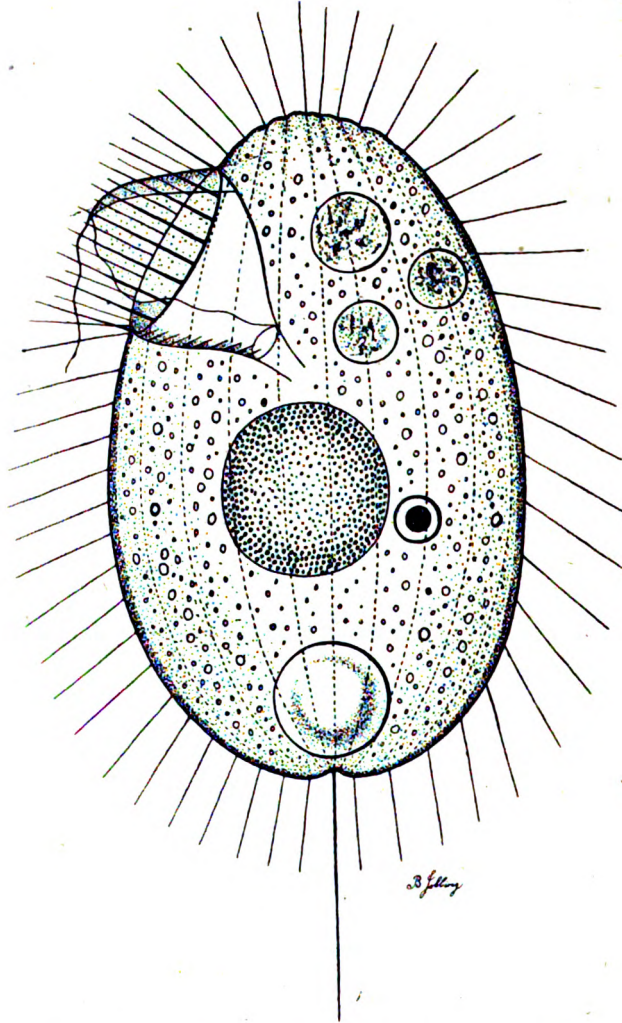


FIG. 3.—An intermediate form ($= 40 \mu$) unstained, with short caudal cilium. (The largest forms are similar but have no "tail.")

The nucleus is spherical, and in unfixed specimens usually measures 9 to 12μ ; it is frequently found shrunken after fixation. The micronucleus usually lies close to the nucleus, sometimes indenting its margin, and is usually 1.8 to 3μ in diameter.

The cytostome is placed antero-laterally, and in the specimens measured it varied from 3.6 to $9\ \mu$ in length and from 1.8 to $4.5\ \mu$ in breadth; it is relatively longer in the smaller forms. The cytostome is surrounded by circumoral cilia, which are longer in the young individuals; and externally is provided with an undulating membrane to which a flagellum is affixed; this sometimes appears adherent throughout its course, and at other times the distal portion is free. (See figs. 2 and 3.)

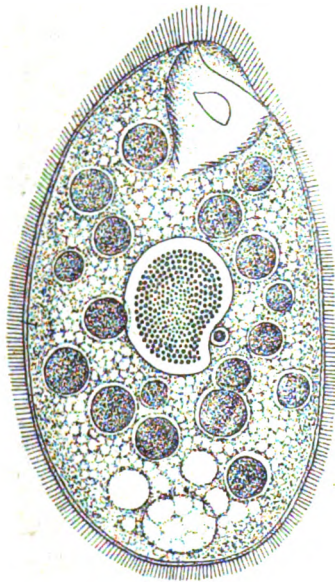


FIG. 4.— $37\ \mu$. Fixed and stained (Schaudinn and Meyer's hæmalum). The cilia have cleared almost to invisibility. Owing to distortion of the cytostome the details cannot be determined. Compare with figs. 2 and 3.

The endoplasm is granular, and usually contains from 1 to 27 food vacuoles. There is a contractile vacuole posteriorly, pulsating at half-minute intervals at room temperature. There is no anus, food remnants being extruded through the cortex.

When the exo-skeleton of an infected larva is ruptured ciliates dash through the breach and swim about most actively, tending to slow down later, but unless the body is very badly damaged many motile ciliates remain inside. One such larva kept under observation in a watch-glass still showed active ciliates after twenty-six days, whereas the ciliates which had been freed in large numbers could not be found alive after fourteen days, though their disintegrating bodies were plentiful. No sign of encystment was observed.

A word of explanation is necessary here regarding the drawings illustrating this article. As there were no facilities at the Army School of

Hygiene for exact work of this nature, I forwarded stained preparations and living ciliates to the Wellcome Bureau of Scientific Research where Dr. Wenyon most kindly supervised the preparation of these figures. Figs. 1, 4 and 5 were drawn from the former; figs. 2 and 3 from the latter.

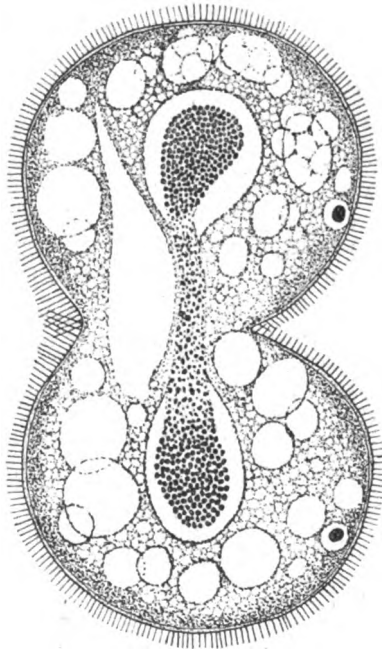


FIG. 5.— = $45.7\ \mu$. Binary fission: fixed and stained (Schaudinn and Meyer's hæmalum).

REPRODUCTION.

Reproduction takes place by binary fission, the products of division being of equal size and spherical at first, later becoming elongated. In the specimens observed, the lateral indentations of the parent form were obvious before the stage of micronuclear rest was reached, and in one instance these indentations were distinct before the nucleus had completed its elongation. Small forms about $8\ \mu$ in length were sometimes present in large numbers, both within infected larvæ and after liberation. At other times these small forms could not be found. I supposed that these resulted from repeated divisions, but on several occasions I observed what might be an example of unequal gemmation. One adult about $30\ \mu$ in length budded off from its ventral surface a spherical body which at first was attached by a pedicle; this slowly lengthened and the new form was towed behind the parent, the interval gradually increasing until the pedicle ruptured. The new body was spherical and measured $9.4\ \mu$, the nucleus being $4\ \mu$ in diameter.

It resembled a product of ordinary binary fission, as seen under similar conditions, except for the difference in size; the process of formation occupied half an hour. I observed this phenomenon twice in one day, but I watched for over a hundred hours before seeing it again. On this latter occasion I removed a pupal fin containing 8 well grown ciliates. They were unable to escape from the fin, and owing to its transparency they could easily be observed. I searched the fin with all powers of the microscope for an hour and a half without finding any bodies other than the 8 large ciliates. After this period several small forms, 9 to 10 μ in length, appeared swimming about inside the fin, and several of the ciliates were watched apparently budding these off; finally the small forms were more numerous within the fin than the large ones. There were no ciliates nor other motile Protozoa in the water in which the fin was mounted. Such a form of multiplication—if my interpretation of this observation is correct—seems extraordinary, though various types of unequal gemmation have been recorded as occurring in other ciliates, *Anoplophrya modulata*, *Hoplitophrya*, *Opalinopsis*, etc.

Nothing resembling an "epidemic of division" was seen, nor could I find any forms in conjugation. It may be recalled that Maupas in his classical studies on *Stylonichia pustulata* observed 215 generations over a period of four months without conjugation.

I did not succeed in finding any indubitable cysts, though ciliates were kept under conditions—desiccation, etc.—which appeared likely to stimulate encystment.

POSSIBLE METHOD OF INFECTION.

When liberated ciliates are kept in a watch-glass with a dead, uninfected larva they make no attempt to invade it. I could not make any satisfactory observations on their behaviour to living captive larvæ, as the struggles of these scattered any ciliates which approached them. 3 *Theobaldia* larvæ kept in small beakers with liberated ciliates did not contract the infection. On the other hand, I examined 15 *Theobaldia* larvæ microscopically on several occasions, failing to find any sign of ciliates, and returned them to the original contaminated water as "healthy"; 3 of these eventually died, showing a heavy and obvious invasion.

As regards transmission of parasitic ciliates, Lamborn found that larvæ of *Stegomyia scutellaris* kept in water infected with *Lambornella stegomyiæ* Keilin, showed infection only after the lapse of three months; also, Brumpt failed to transmit *Anoplophrya brachiarum* Balbiani from infected to healthy *Asellus aquaticus* by keeping them together for one month.

I think that infection of the larva probably occurs by ingestion of small ciliates; these might readily pass through the gut wall into the blood cavity, and so spread over all the body. Large ciliates may be seen

in various places where they could have entered only when small, for example, inside the bar of the pupal fin.

POSITION OF THE CILIATE.

From text descriptions and from the incomplete figure reproduced in Brumpt's "Précis," I thought this ciliate might belong to the genus *Uronema* Dujardin. Wenyon has examined some of my specimens and regards them as possibly belonging to the genus *Cyclidium* Claparede and Lachmann or to the genus *Pleuronema* Dujardin. He points out that *Pleuronema*, as described, differs from *Cyclidium* in having a longer cytostome, and in the absence of a "tail," and that in the ciliate under consideration the small individuals have a long "tail" and a long cytostome, whilst the largest have a relatively short cytostome and no "tail." He makes the very interesting observation that different stages of this ciliate show a transition from long tailed to tailless forms; from a long to a short cytostome; and from long to short peristomal cilia, and that these transitions appear to cut across characters on which a number of different genera have been founded, and that possibly *Uronema*, *Cyclidium*, *Pleuronema*, and *Glaucoma* may all belong to the same genus.

ACKNOWLEDGMENTS.

I have already explained my indebtedness to Dr. Wenyon in connection with the drawings for this article; I wish to thank him further, and also Dr. S. H. Daukes, for the great interest and trouble taken in connection with this work.

I am much obliged to Dr. Keilin, of Cambridge University, for examining some of my preparations and confirming my opinion that the ciliate under discussion is not his recently described parasite *Lambornella stegomyiae* Keilin, and also for the interest he took in this investigation.

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MALARIA IN MACEDONIA, 1915-1919.

PART III.

HÆMATOLOGICAL INVESTIGATIONS ON MALARIA IN MACEDONIA.

By KENNETH McLAY.

Temporary Captain Royal Army Medical Corps.

THE work of this department of the Malaria Inquiry Laboratory commenced in February, 1918, and continued till February, 1919. It may be summarized under the following headings:—

(1) General Hæmatological Work in the Special Malaria Wards of the Fifty-second General Hospital.

(2) Persistence of *Plasmodium vivax* under various forms of treatment.

(3) Local and General Reactions after the Intramuscular Injection of Quinine Salts.

(4) Leucocyte Counts in Malaria and their relation to Pyrexia.

(5) Effect of Antipyrine upon the Leucocytes.

(6) Fragility of the Erythrocytes in Malaria.

(7) The Asexual Cycle of *P. vivax* and the effect of Quinine administration.

(8) Cultivation of the Malarial Parasite in vitro.

(9) Malaria amongst Macedonian Children.

GENERAL HÆMATOLOGICAL WORK.

A great part of the work of this department consisted of the routine examination of blood films from the special malaria wards of the Fifty-second General Hospital, to which the Malaria Inquiry Laboratory was attached. Some 6,489 such films were examined. A careful record was kept of the type and stage of parasite observed in each film, and, to ensure accuracy, no diagnosis of type was made where only a scanty number of young "signet-rings" was found. Of the 6,489 films examined, 2,085 showed malaria parasites (benign tertian, 1,362, subtertian 448, "young rings," 275).

The following table will give some idea of the type of case admitted to the special malaria wards from February, 1918, to February, 1919, but it must be pointed out that although 562 cases did not give a positive blood film at any time while under observation, no case was admitted unless the patient had given a positive blood film in the hospital from which he had just come.

94 *Hæmatological Investigations on Malaria in Macedonia*

ANALYSIS OF 1,136 CASES TREATED IN THE SPECIAL MALARIA WARDS (FEBRUARY, 1918, TO FEBRUARY, 1919.)

<i>Plasmodium vivax</i> ..	..	..	..	..	..	462
<i>falciparum</i> ..	..	..	..	..	65	} .. 100
"Rings," probably <i>P. falciparum</i> ..	..	..	..	..	35	
of doubtful type ..	..	..	..	..	..	33
<i>P. vivax</i> + <i>P. falciparum</i> ..	..	..	..	..	..	9
Negative ..	..	..	..	..	..	562
						1,136

No case of quartan malaria came under observation.

Of 586 cases, where a blood film was examined on the day of admission to the special malaria wards, only twenty-three gave a positive result, that is, 3·9 per cent. Of these twenty-three, seven showed only the gametocytes of *P. falciparum*. The actual percentage of cases, therefore, with evidence of active malaria on admission was 2·7.

The Seasonal Incidence of Subtertian Malaria.—The following figures are those of the actual numbers of films found to show *P. falciparum* during the year:—

Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
83	(6)	20	1	0	0	4	13	29	31	28	233

The small number in February is accounted for by the fact that the hæmatological work only commenced towards the end of that month.

The Seasonal Incidence of Gametocytes in Routine Blood Films.—An attempt was made to ascertain whether the sexual forms of the malarial parasite show any seasonal fluctuation but the figures obtained month by month were too varied to show any seasonal rise and fall.

THE RELATIVE PERSISTENCE OF *PLASMODIUM VIVAX* UNDER ORAL, INTRAMUSCULAR AND SUBCUTANEOUS ADMINISTRATION OF QUININE.

To ascertain whether the malarial parasite disappears from the peripheral blood more rapidly under one form of quinine therapy than another, observations were made upon three four-day courses of treatment, each of sixty grains per diem as follows:—

(a) *Intensive oral course* of three twenty-grain doses of quinine hydrochloride, by mouth, each day for four days.

(b) *Intensive intramuscular course* of two twenty-grain doses of quinine bihydrochloride intramuscularly, and one twenty-grain dose of quinine hydrochloride, by mouth, each day for four days.

(c) *Intensive subcutaneous course*, similar to the intramuscular course, except that subcutaneous injections were substituted for the intramuscular.

In all cases there was a definite benign tertian parasite positive relapse when treatment was instituted. Daily blood examinations were made until two consecutive negative results were obtained.

It will be noted that the blood films became negative earlier under oral administration than under either intramuscular or subcutaneous administration, the figures for these latter forms of treatment being very similar.

Day on which blood film became negative	Oral course	Intramuscular course	Subcutaneous course
1st day	0	0	0
2nd "	13.3 per cent	7.0 per cent	0
3rd "	68.3 "	39.6 "	44.4 per cent
4th "	16.7 "	41.4 "	44.4 "
5th "	1.7 "	8.6 "	11.1 "
6th "	0 "	3.4 "	0 "
Number of cases ..	60	60	9

Days first to fourth in table are the actual days of treatment.

These figures are of interest in view of the finding by Captain T. S. Hele, Physiological Chemist to the Malaria Inquiry Laboratory, that there is a "more rapid excretion of quinine (in the urine) after oral administration on a healthy stomach than after intramuscular administration."

LOCAL AND GENERAL REACTION AFTER THE INTRAMUSCULAR INJECTION OF QUININE SALTS.

A rise in the temperature at or towards the end of a four-day intramuscular course of quinine is a common clinical phenomenon. The following table shows the incidence of this end-temperature in a series of 129 cases.

	Oral course	Intramuscular course	Subcutaneous course
Number of cases investigated ..	60	60	9
Percentage of cases showing end-temperature of 100°F. and above	0	55 per cent	11 per cent

During none of these end-temperatures were malarial parasites found in the blood film, so that we are not dealing with a relapse of the disease.

A theory was brought forward that this temperature is an outward manifestation of a destruction of parasites in the visceral circulation, with liberation of toxins. One may well ask why such an explanation, with no real evidence to support it, is sought when we have a much more obvious cause in the painful, indurated swelling so frequently seen at the site of injection in the patient's gluteal muscles. In February, 1918, Colonel C. M. Wenyon, was able to demonstrate, in the Malaria Inquiry Laboratory, the histological changes in a gluteal muscle from a patient who had had an intramuscular injection of quinine bihydrochloride two days before death. An extraordinary degree of inflammatory reaction and tissue necrosis was revealed at the site of injection. Since then, a series of experiments in animals, showing similar muscle changes after the injection of quinine salts, has been published by Colonel L. S. Dudgeon.

The local inflammatory reaction at the site of intramuscular injection is reflected in the following series of leucocyte counts. These were made

96 *Hæmatological Investigations on Malaria in Macedonia*

in four cases, commencing two days before and carried out daily during quinine administration. Two cases were given oral quinine and two intramuscular quinine. No malarial parasites were found in the blood films during the period of observation. All symptoms of malaria were absent.

ORAL QUININE.

(20 gr. quin. hydrochlor. t.d.s. for four days.)

		Leucocytes per c.mm.	Mast cells	Eosinophiles	Neutrophiles	Large and small lymphocytes	Large monos. and transitionals
Case M. 2004—							
9 a.m.	9.5.18	8,300	—	0.6	52.8	39.8	6.8
"	10.5.18	4,300	—	0.6	51.8	40.4	7.2
"	11.5.18	5,100*	0.2	0.8	56.0	34.4	8.6
"	12.5.18	8,600*	—	1.8	63.0	29.8	5.4
"	13.5.18	7,700*	—	0.4	53.4	36.0	10.2
"	14.5.18	6,600*	—	1.2	47.4	42.0	9.4
Case M. 2025—							
10 a.m.	10.6.18	3,400	0.8	0.4	45.0	42.4	11.4
"	11.6.18	10,400	0.2	0.4	54.6	36.8	8.0
"	12.6.18	7,500*	0.2	—	61.4	31.6	6.8
"	13.6.18	6,600*	0.6	0.8	58.4	33.4	6.8
"	14.6.18	10,000*	0.6	0.4	61.6	30.0	7.4
"	15.6.18	7,200*	—	0.8	46.0	45.4	7.8

* = days of treatment.

In these two cases, under oral quinine, there is no leucocyte change.

INTRAMUSCULAR QUININE.

(Two 20 gr. quin. bihydrochlor. intramuscularly, and 20 gr. quin. bihydrochlor. orally per diem for four days.)

		Leucocytes per c.mm.	Mast cells	Eosinophiles	Neutrophiles	Large and small lymphocytes	Large monos. and transitionals
Case Jackson—							
9.30 a.m.	21.9.18	11,200	0.2	0.6	62.4	28.8	8.0
"	22.9.18	10,700*	0.2	1.0	61.4	32.6	4.8
10.45 a.m.	23.9.18	18,000*	—	0.6	72.4	19.6	7.4
9.30 a.m.	24.9.18	23,100*	0.2	0.4	74.4	19.8	5.2
"	25.9.18	24,600*	0.6	0.2	73.6	20.0	5.6
"	26.9.18	22,400	0.4	2.0	66.8	26.4	4.4
"	27.9.18	13,000	—	2.6	68.0	25.6	3.8
"	28.9.18	10,800	0.6	2.4	55.4	35.6	6.0
Case Heslop—							
9.30 a.m.	21.9.18	8,500	0.2	1.6	47.8	42.2	8.2
"	22.9.18	9,600*	—	0.4	47.4	45.2	7.0
10.45 a.m.	23.9.18	12,400*	0.2	0.4	64.0	29.6	5.8
9.30 a.m.	24.9.18	17,200*	—	0.2	70.2	24.6	5.0
"	25.9.18	28,000*	—	0.2	80.0	16.4	3.4
"	26.9.18	28,000	—	0.2	74.4	20.6	4.8
"	27.9.18	28,100	—	0.4	55.6	39.0	5.0
"	28.9.18	14,000	0.6	0.8	63.8	29.8	5.0

In the above two cases, under intramuscular quinine, a rise in the total number of leucocytes, together with a relative increase in neutrophiles, took place on the second day of treatment. The leucocytosis was maintained for five or six days and was coincident with a rise in temperature.

THE LEUCOCYTES IN MALARIA AND THEIR RELATION TO TEMPERATURE.

Total and differential leucocyte counts were made in thirty-one cases of benign tertian malaria, while the *Plasmodium vivax* was demonstrable in the blood and before quinine had been administered in any form to the patient. In twenty-one cases the count was made when the patient's temperature was under 100° F. In the other ten cases the temperature was 100° F. or above. The results of these counts are tabulated below, together with ten others made in a series of ten apparently healthy individuals who had spent periods from ten to thirty-two months in Macedonia without having shown any symptoms of malarial infection. In the malarial cases 500 cells were enumerated in making the differential count. In the case of healthy individuals, 1,000 cells were counted.

The results obtained show a very slight increase in the total number of leucocytes during pyrexia but in no case reaching the average figure of 9,900 given by the healthy men. The mast cells remain constant in their proportions. The eosinophile count is diminished in malaria, most markedly during pyrexia. The neutrophiles show a distinct increase in their numbers during the febrile period, the lymphocytes being relatively diminished. The increase in large mononuclears and transitionals during apyrexia closely approximates the figure of fifteen per cent regarded by Christopher and Stephens as evidence of active malaria.

The results obtained from the apparently healthy individuals are of interest, corroborating to some extent the relative increase in lymphocytes noted by various pathologists in France during the war. The only previous observations which seem to shed any light upon this lymphocyte increase are those of Cabot, who describes a lymphocytosis in debility without apparent cause. War strain may be the explanation of the figures obtained in France and Macedonia, and it would be of interest to know whether similar counts were obtained at home during the war period.

The total and differential leucocyte count is of undoubted value in the diagnosis of malaria, but a really diligent search for parasites must come first. One feels that, in Macedonia, the time of pathologists was often wasted by the indiscriminate sending of scores of blood films from the hospital wards, for the number of such specimens that can be efficiently examined by an individual in one day is limited. More benefit would probably have been reaped by more concentration upon really doubtful cases. A case with high temperature, whether of the benign or subtertian type of malaria, may show extraordinarily few parasites in the blood film, and to find these much time and patience are required. It is important, therefore, that the latter should not be wasted.

98 *Hematological Investigations on Malaria in Macedonia*

THE LEUCOCYTES IN MALARIA AND THEIR RELATION TO TEMPERATURE.

Temperature below 100° F.

Temperature	Leucocytes per c.mm.	Mast cells	Eosinophiles	Polymorpho- nuclears	Lymphocytes	Large monos. and transitionals
98.0° F.	8,400	0.1	3.9	47.6	40.9	7.5
97.4° F.	6,600	—	1.4	51.0	86.8	10.8
98.4° F.	7,900	—	2.0	60.4	23.0	14.6
99.4° F.	8,700	0.2	1.6	57.2	21.2	19.8
98.4° F.	7,300	0.2	1.8	45.0	29.4	23.6
98.4° F.	6,000	—	0.8	62.4	23.2	13.6
99.0° F.	5,800	0.4	1.8	70.6	20.2	7.0
99.4° F.	5,200	0.4	2.0	56.0	29.6	12.0
99.0° F.	5,200	0.8	2.6	58.0	29.0	9.6
99.4° F.	5,500	0.4	1.8	63.8	18.0	16.0
98.6° F.	5,400	0.6	0.6	52.4	22.8	23.6
98.0° F.	5,400	0.2	1.8	52.0	31.6	14.4
99.6° F.	5,000	0.2	0.8	61.0	21.0	17.0
98.6° F.	5,400	0.2	1.6	66.4	17.8	14.0
99.8° F.	4,900	—	—	71.5	16.0	12.5
99.6° F.	*13,600	0.4	1.8	85.8	8.8	3.2
98.0° F.	7,000	0.6	0.8	58.0	22.8	17.8
98.2° F.	7,000	0.4	1.2	61.2	21.2	16.0
98.2° F.	8,600	—	3.0	63.4	21.8	11.8
98.2° F.	8,300	0.6	2.8	58.0	25.4	13.2
99.4° F.	5,200	0.8	0.8	51.6	29.4	17.4
Average	6,700	0.3	1.6	59.7	24.3	14.1

* Four hours before rigor.

Temperature 100° F. and above.

104.0° F.	7,800	—	0.8	82.4	12.0	4.8
100.4° F.	9,300	—	0.2	70.8	16.4	12.6
101.0° F.	7,700	—	0.6	86.8	9.0	3.6
103.8° F.	7,000	—	1.2	82.8	10.6	5.4
101.8° F.	4,500	0.4	0.4	65.2	20.8	13.2
104.6° F.	4,700	—	0.2	80.2	7.0	12.6
104.0° F.	8,900	0.4	0.4	85.2	7.8	6.2
100.2° F.	7,600	0.4	0.2	71.2	14.6	13.6
101.0° F.	5,000	0.4	—	61.4	22.4	15.8
101.0° F.	9,600	0.4	4.6	67.6	22.8	4.6
Average	7,200	0.2	0.9	75.4	14.3	9.2

THE LEUCOCYTES IN APPARENTLY HEALTHY MEN.

Service in Macedonia	Leucocytes per c.mm.	Mast cells	Eosinophiles	Polymorpho- nuclears	Lymphocytes	Large monos. and transitionals
22 months	8,800	0.2	3.8	44.2	46.4	5.4
22 "	8,900	—	0.6	65.9	24.2	9.3
11 "	8,100	0.5	4.3	49.5	39.0	6.7
22 "	8,400	0.6	2.6	62.3	25.7	8.8
10 "	10,300	0.6	7.2	47.9	37.0	7.3
32 "	12,600	—	1.9	54.3	40.2	3.6
14 "	12,600	0.3	1.4	64.5	29.0	4.8
12 "	8,800	0.4	1.3	55.8	34.1	8.4
12 "	11,700	0.1	3.5	65.7	26.1	4.6
12 "	9,200	0.2	1.4	57.7	34.8	5.9
Average	9,900	0.3	2.8	56.8	33.6	6.5

As regards the finding of pigmented mononuclear leucocytes and the value of these in diagnosis, our experience has been that there are very few cases where they are present where parasites themselves will not be found on careful search.

THE EFFECT OF ANTIPYRINE UPON THE LEUCOCYTES.

When it was discovered that the French medical authorities in Salonika were adding antipyrine to the quinine solution used by them for subcutaneous injection, and since von Jaksch and others are stated by Cabot to have obtained a leucocytosis by the hypodermic injection of this drug, a series of total and differential leucocyte was made to corroborate this statement, if possible, in view of the possibility of phagocytosis by the polymorphonuclear leucocytes being a factor in the destruction of the malaria parasite. It will be pointed out below, however, in dealing with the cultivation of the parasite, that the evidence is in favour of the mononuclear and not the polymorphonuclear leucocyte being the important factor in this direction. Two injections of antipyrine in aqueous solution were given with the following results.

		Leucocytes per c. mm.	Mast cells	Eosinophiles	Neutrophiles	Large and small lymphocytes	Large monos. and transitionals
Case I—							
28.4.18	10.45 a.m.	11,400	0.2	1.2	54.0	34.6	10.0
29.4.18	10 "	8,700	—	1.4	48.0	35.4	15.2
"	11.0 "	Antipyrine, gr. iii, given subcutaneously					
"	3.0 p.m.	9,600	—	1.2	54.8	34.6	9.4
"	7.0 "	12,400*	—	1.3	48.2	41.3	9.2
"	11.0 "	13,200*	0.2	—	48.0	40.8	11.0
30.4.18	7.0 a.m.	9,800	0.2	1.8	52.4	37.0	8.6
"	11.0 "	8,800	—	0.8	51.6	37.0	10.6
Case II—							
9.5.18	11.0 a.m.	10,700	0.4	2.0	50.8	40.4	6.4
10.5.18	11.0 "	9,900	0.2	0.2	50.0	39.0	10.6
"	11.0 "	Antipyrine, gr. v, given subcutaneously					
"	3.0 p.m.	10,200	0.2	0.4	45.8	45.4	8.2
"	7.0 "	12,900	0.2	—	51.6	39.4	8.8
"	11.0 "	10,600	—	—	—	—	—
11.5.18	3.0 a.m.	9,200	—	—	—	—	—
"	9.0 "	10,800	—	—	—	—	—
"	7.0 p.m.	10,800	—	—	—	—	—
12.5.18	9.0 a.m.	8,700	—	—	—	—	—

In the first case, where the smaller dose was given, a slight reaction is indicated by an asterisk. This slight leucocytosis was coincident in time with slight local tenderness and discomfort at the site of injection. It seems, therefore, that any leucocytosis that may arise from the injection of antipyrine is due to the local trauma and not to any special action of the drug *per se*.

THE FRAGILITY OF THE RED BLOOD CORPUSCLES IN MALARIA.

The method adopted in this investigation was essentially that described by Daniels in his "Laboratory Studies in Tropical Medicine," 1911, except that an effort was made to estimate the rate of hæmolysis. A series of solutions of sodium chloride was prepared, ranging from 0.75 per cent, 0.73 per cent, 0.71 per cent, and so on, down to 0.29 per cent. A measured quantity of blood was taken up in a hæmocytometer pipette and each saline solution used in turn as the diluting fluid, with the object of obtaining a quantitative result. The red cells of a given blood do not all undergo hæmolysis in the same saline dilution. Thus, although hæmolysis may start in the 0.45 per cent solution, apparently unchanged red cells may still be found in the dilution of 0.29 per cent. The number of cells remaining unchanged in each solution was estimated in order to ascertain whether hæmolysis is more rapid, or otherwise, in malaria, although the fragility point (the lowest saline dilution in which no hæmolysis takes place) may be normal.

Investigations were carried out in eight cases of malaria, during various stages of the illness, but in no case could any deviation from the normal be obtained, either in the fragility point or in the degree of hæmolysis in the lower saline dilutions. The results obtained are tabulated below, with a note on the clinical features of each case :—

Clinical note								Fragility point
1.	Normal case	..	..	..	..	..	..	0.47
2.	"	..	..	..	..	..	..	0.47
3.	"	..	..	..	..	..	..	0.45
4.	Blood taken during rigor (benign tertian)	..	..	..	..	..	..	0.47
5.	"	..	..	..	..	..	..	0.47
6.	Day after rigor	"	"	"	..	..	..	0.47
7.	"	"	"	"	..	..	..	0.47
8.	"	"	"	"	..	..	..	0.45
9.	No rigor, but benign tertian parasites present in blood	..	..	..	..	..	..	0.45
10.	Hæmoglobinuria ten days previously; subtertian rings present in blood	..	..	..	..	..	..	0.45
11.	Day after rigor (benign tertian)	..	..	..	..	..	..	0.45
12.	Case of splenomegalic polycythæmia	..	..	..	..	..	..	0.53

Case 12 came under observation in another hospital in Salonica in 1917, and is incorporated here as an instance of increased fragility of the red blood corpuscles.

One recognizes, as Colonel Wenyon has pointed out, that in such experiments as these very artificial conditions prevail. It is possible that other methods may show some alteration in the physical state of the red cells in malaria or, more probably, in blackwater fever.

THE ASEQUAL CYCLE OF PLASMODIUM VIVAX AND THE EFFECT OF QUININE ADMINISTRATION.

In three cases of benign tertian malaria four-hourly blood films and leucocyte counts were made. In each film the ratio of parasites to leucocytes was found, 500 leucocytes being counted. From the ratio thus obtained and the total leucocyte count, the number of parasites per cubic

millimetre of blood was calculated. The forms (or ages) of parasites found at each four-hourly period and their relative proportions were carefully noted. Some interesting results were obtained and these are shown graphically.

Case 1.—This patient had a rigor and temperature of 104° F. on June 8, 1918. No quinine was given on that day and on the following day no rise in temperature occurred. The case was, therefore, to all appearances, one of single benign tertian infection. Thirty grains of quinine bihydrochloride were given on the evening of June 9 and the effect of this dose was observed upon the parasites as seen in the four-hourly blood film.

It will be noted from the accompanying chart that the young signet-ring forms of parasite persisted in the peripheral blood till about sixteen hours after the rigor, being then replaced entirely by older forms. These older forms show an immediate and regularly maintained diminution in numbers on the administration of quinine. This seems to show that quinine has an action upon the intracorpuseular parasite. It was observed clinically in numerous cases of benign tertian malaria in the special malaria wards that the rigor due two days after an untreated attack could be aborted by quinine administration on the intervening day, but that this was unsuccessful if treatment was delayed till the day of the expected rigor.

Case 2.—In this case a rigor, with temperature of 103·8° F. on May 24, 1918, was followed by another rigor, with temperature of 105° F. on May 25, showing the case to be one of double benign tertian infection. Quinine hydrochloride was given orally immediately after the second rigor and continued in twenty-grain doses till May 27, when the parasites disappeared from the blood film, 120 grains in all being given.

Chart II shows an immediate diminution in the number of parasites on the administration of quinine. In contrast to Case 1, the young signet-rings persist throughout the period of observation, showing at the time of rigor, however, a wave-like increase.

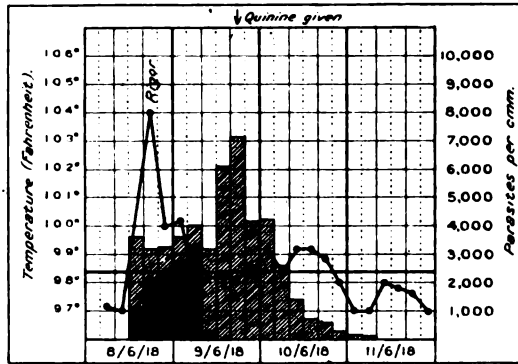
Case 3.—As in Case 2, we have here a double benign tertian infection, with quotidian temperature. This patient was treated by intramuscular injections of quinine bihydrochloride, in twenty-grain doses, commencing immediately after the second rigor and continued till May 15. The response to treatment appears to be slower than in Case 2, as estimated by the fall in the number of parasites. (Is this due to the slower absorption of intramuscular quinine, as already suggested in the paragraph on the persistence of *P. vivax* under intensive oral and intramuscular quinine courses?) As in Case 2, the young signet-rings are present throughout the cycle.

From these investigations into the benign tertian cycle, it would appear :

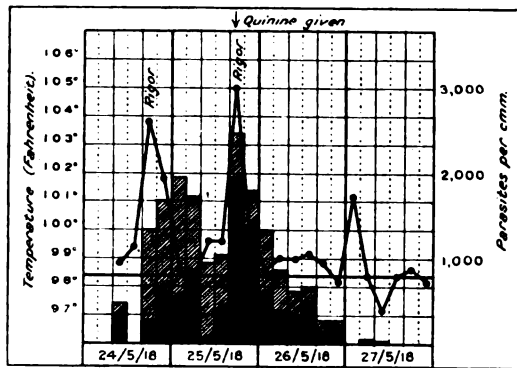
(1) That, while in single infections young signet-rings are present in the peripheral blood for a limited period of about sixteen hours, in double infections there is a continuous sporulation of young parasites which, however, reaches a diurnal maximum coincident with the daily rigor.

(2) That the administration of quinine is followed by an immediate

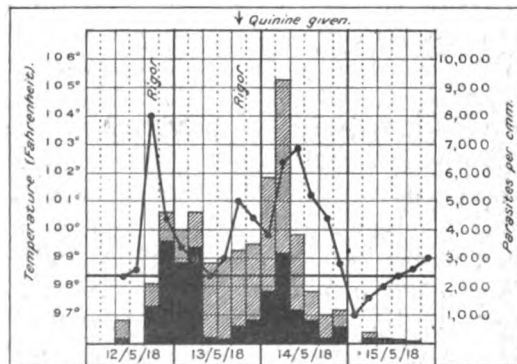
THE ASEQUAL CYCLE OF *Plasmodium vivax*.



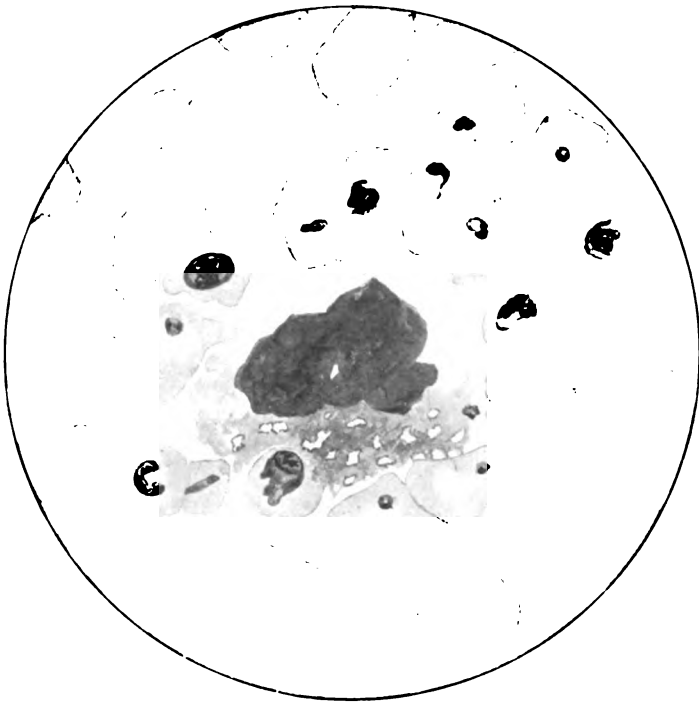
CASE 1.—Single infection of benign tertian malaria treated with one dose of oral quinine.



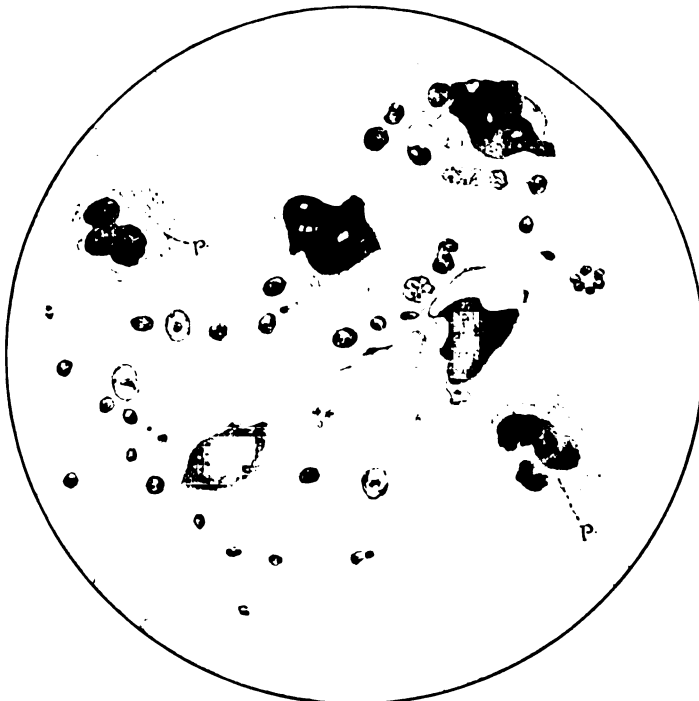
CASE 2.—Double infection of benign tertian malaria treated with oral quinine for three days.



CASE 3.—Double infection of benign tertian malaria treated with intramuscular quinine for five days.



Clumping of the Malignant Tertian Parasite around a Large Mononuclear Leucocyte in Culture (45 hours).



Clumping of Parasites around Large Mononuclear Leucocytes but not around the Polymorphonuclear Leucocytes (P) in Culture (34 hours).

and gradual diminution in the number of parasites as seen in the blood film.

(3) That there is some evidence that quinine acts not merely upon the young sporulating merozoites, but also upon the partially grown intra-corpuseular forms of the parasite.

THE CULTIVATION OF THE MALARIAL PARASITE.

(a) *Plasmodium malariae*.—In the summer of 1917, from a case showing quartan rings, schizonts and partially grown parasites, Colonel Wenyon obtained at the end of forty-eight hours' cultivation by Bass's method, full grown seventy-two hours old schizonts—that is, the partially grown forms of the original blood had completed their development. The red blood corpuscles were apparently healthy at the end of the period of cultivation.

(b) *Plasmodium vivax*.—Repeated attempts were made, during 1918, to cultivate this parasite by the methods of Bass, Row and the Thomsons. The only success attained was in one case where half-grown pigmented parasites were obtained from the young rings of the original blood. In all cases the red blood corpuscles showed degenerative changes during the process of culture.

(c) *Plasmodium falciparum*.—The cultivation of this parasite was accomplished by the method of the Thomsons. Unsuccessful attempts to cultivate this parasite had been made previously in the Malaria Inquiry Laboratory and several other laboratories in Macedonia. The reason for the success attained in this case lies probably in the fact that the patient, whose blood was employed, was heavily infected with subtertian malaria and had had no quinine during the seven days of his illness. He had been sent down to the base at Salonika as a case of influenza. The whole forty-eight hours' cycle was obtained in the culture and a second generation produced.

AGGLUTINATION OF INFECTED RED BLOOD CORPUSCLES AROUND THE LARGE MONONUCLEAR LEUCOCYTES.

In the numerous stained blood films obtained from the culture tubes, an interesting phenomenon was observed in the clumping of red blood corpuscles, containing malarial parasites in all stages of development, around the large mononuclear leucocytes. No such agglutination was observed around the other types of leucocyte—polymorphonuclear, etc.

Pigmented mononuclear leucocytes increase in numbers in the culture films as the process of cultivation goes on, and appear to be an important factor in the dying out of the parasites. Pigmented mononuclears are seen so frequently in ordinary blood films, that one is led to the conclusion that they are an important defensive weapon of the body. The clumping noted in the cultures suggest that there is a positive chemiotaxis between the large mononuclear leucocyte and the malarial parasite.

104 *Hæmatological Investigations on Malaria in Macedonia*

THE INCIDENCE OF MALARIA AMONGST MACEDONIAN SCHOOL CHILDREN.

As in other infectious diseases, the "carrier" plays an important part in the dissemination of malaria. This influence was combated amongst the British troops in Macedonia by the use of mosquito nets, but there still remained a potent source of infection amongst the malarious native population. An investigation was therefore made to obtain some idea, by blood examinations, of the prevalence of malaria amongst the Macedonian school children. These were selected more or less at random, the majority actually attending school when the blood films were obtained. Many appeared to be in very poor health, and the "spleen index," though not actually estimated in figures, was evidently high. The following results were obtained :—

Village	No. of cases	<i>P. falciparum</i>	<i>P. vivax</i>	<i>P. malariae</i>	<i>P. falcip.</i> + <i>P. vivax</i>	Rings	Per cent Positive
Lahana (Oct., 1917) ..	8	3	1	1	0	1	75 per cent
Ravna (" ") ..	8	0	1	1	0	0	25 "
Lahana (June, 1918) ..	52	5	15	3	2	4	55 "
" (Nov., ") ..	57	7	12	1	0	8	49 "
Stonmica (Oct. ") ..	38	2	4	1	0	5	31 "
Bosiljovo (" ") ..	18	1	0	1	0	0	11 "
Dobilja (" ") ..	17	2	1	0	1	0	23 "
Turnova (" ") ..	22	2	1	2	0	3	36 "
Sekirnik (" ") ..	19	1	2	6	0	1	52 "
Yenikoj (" ") ..	18	1	3	0	0	1	27 "
Total ..	257	24	40	16	3	23	41 per cent

The number of children, therefore, actually showing malarial parasites in the blood was found to be 41 per cent, the figure varying in the different villages from 11 to 75 per cent, indicating an extreme prevalence of malaria amongst the natives in Macedonia and a very fertile source of infection for our troops in that country.

A feature worthy of note in these figures is the number of cases of quartan malaria discovered. This parasite was found in all the villages but two, and, in one village, Sekirnik, it was the predominating type (in six of the ten positive films). These findings are remarkable in view of the very infrequent diagnosis of quartan malaria amongst British troops in Macedonia.

The last six villages tabulated above are in the Strumica Valley, held by the Bulgarians till October, 1918. Our late enemy, therefore, had an intensely malarious country on his side of the line as we had on ours.

CONCLUSIONS.

The principal aim in the hæmatological work of the Malaria Inquiry Laboratory in Salonika was to obtain evidence of the efficacy of the various modes of administering quinine in malaria. The results attained are in

favour of the administration of the drug by mouth as opposed to the intramuscular route in the treatment of the ordinary case of malaria, that is, the case where quinine is tolerated by the alimentary canal. Some evidence has been obtained that the malarial parasite disappears more rapidly from the blood by oral than by intramuscular administration of quinine. The subcutaneous method gives similar results to the intramuscular.

The great objection to the intramuscular injection is the intense reaction, sometimes amounting to abscess formation, and discomfort which it produces in the patient. These are not justified unless some compensation is afforded in the way of more effective destruction of the parasite, of which there is no evidence. This method should be reserved entirely for cases where the oral route is impossible.

Four-hourly observations upon the asexual benign tertian cycle appear to show that quinine has an immediate effect upon the malarial parasite, not only upon the young sporulating merozoite but also upon the intracorpuseular stage.

Sporulation of the parasite in a single infection of benign tertian malaria seems not to be limited merely to the actual time of rigor but to be spread over a period of a few hours, with a wave-like rise during the rigor. In the case of a double benign tertian infection the sporulation seems to be continued throughout the whole cycle, with the same wave-like increase at the time of rigor.

The cultivation of the malarial parasite *in vitro* is very uncertain and appears to be adversely influenced by the presence of quinine in the body.

The large mononuclear leucocytes seem to be greatly attracted by the malarial parasite, in whose destruction they probably play an important part.

The leucocyte count is of undoubted value in the diagnosis of malaria, but a careful and, if necessary, prolonged search for parasites must not be neglected.

No evidence has been obtained that there is any increased fragility of the red blood corpuscles in malaria.

Investigations carried out amongst Macedonian school children point to an extreme endemicity of malaria in the native population and a peculiar prevalence of the quartan type of the disease not found amongst the British troops.

I wish here to take the opportunity of expressing my thanks to Sergt. W. J. Muggleton, M.S.M., for his extremely valuable assistance throughout the hæmatological work. Without his zeal the investigations would have been much curtailed.

THE CONVALESCENT DEPOT AS A PERMANENT PEACE ORGANIZATION.

BY MAJOR G. R. PAINTON.

Royal Army Medical Corps.

A SHORT time ago we read in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS an admirable account of one of our convalescent depots, operating during the last stages of the war. It was one of many and formed part of a "convalescent centre," and as such, was actually the "specializing" of a "general idea" for the treatment and disposal of the soldier who was slightly wounded or not seriously ill, during the period when the enemy's submarine activity was at its maximum intensity.

It was an idea brilliantly conceived and ably carried out and is one of the outstanding administrative successes of the war.

As an onlooker one is said to see most of the game, and as that unhappy position was my lot, a first rush into print in the shape of the above remarks will it is hoped be pardoned.

One has a right to expect a sympathetic reading from every one except, perhaps, the finance department, with which all of us can sympathize. I will put it to the economist now, that a well run convalescent depot will help to produce more quickly than any other means a working-fit soldier out of a recently sick one—provided of course that the importance of the convalescent interval between these states is admitted—without any great demand on the treasury's purse.

In war, the momentous questions of transport, morale, physical fitness, time and money, had to be considered in dealing with the convalescent, almost in this sequence of importance; and though this sequence may be reversed, or altered, one presumes to say that the importance, at present at any rate, still exists as far as physical fitness, morale, transport, time and consequently money are concerned.

In peace as well as in war there always exists a gap between the genuine hospital patient and the physically, mentally and morally fit soldier. Into this gap drift the "light duty" and "excused duty seven days" cases, the man excused wearing boots or puttees, and the "attend hospital" type of soldier, there to be a nuisance to their company-serjeant-major and bad examples in the barrack-room.

In this gap they fend for themselves, away from medical supervision, and with the obvious and ready rejoinder if they are warned for any fatigues. It is the nursery of the lead-swinging cult, and the lucky escape from that necessary discipline which is so irksome to the lazy soldier.

I am one of those who consider that no sick soldier should go back to his battalion from hospital until he is quite fit for his regimental physical training and his guards and route marches.

This gap was cleared periodically in terms of one or other of the subparas. of 392 King's Regulations.

It is believed that many soldiers disappear from the army after much money has been expended on their training, etc., because of the absence of control over them while they are in this gap between the medical officer and the physical training instructor.

Many cases are invalided home from foreign service or lost to the army altogether, for example: the so-called D.A.H., who is often a victim of diagnosis, and who might have been saved.

How often have we heard the unit company officer say, "I don't know what to do with Private X., the doctors won't invalid him and yet he does no work and falls out on all marches and is such a bad example to the rest of the men." Well, it ought to be possible to send that man somewhere where he can be watched and exercised by the medical officer. It ought to be possible to send him there direct from his regimental medical officer without admission to hospital.

The weedy recruit too, not quite up to regimental physical training, should have a modified course given him by those who make a study of his type. He should come direct from the regimental medical officer after consultation with the physical training expert.

All such cases mentioned above should filter through to a convalescent depot, in addition to the soldier convalescent from some illness for which he has been in hospital.

Beside the physical side one must put the mental or moral side. A convalescent mind is plastic for all sorts of impressions, and the impressions to be avoided by the young convalescent mind are found in plenty in the "gap."

Healthy and regulated exercise, and healthy and regulated amusement, are essential to the young man who happens to have got ill, and who may be a future regimental serjeant-major or the battalion's bad hat, according to the care devoted to this period of his service.

A properly constituted command convalescent depot, with a system of recreational training which can be evolved in a short time, in any command, by the right type of officer of the corps, would bridge the gap.

It would be welcomed by the officer commanding the battalion and by the superintendent of physical training. It would be in close and sympathetic touch with both these officers.

It is not proposed in this article to suggest a system nor define an establishment, but merely to raise the principle of the convalescent depot in peace.

It would not be a hospital. It would be a depot. Though some cases would require modified rationing the convalescent soldier would have pay and privileges just as when he is with his battalion. It would be organized on some system of convalescent companies with Royal Army Medical Corps company officers and would have a small sick-bay and one

108 *Convalescent Depot as a Permanent Peace Organization*

or two specialists such as a masseur and a physical training instructor of the Royal Army Medical Corps. It would have also an education and entertainment department. Its cost would be small; the soldiers' training would be continuous, and it would dovetail in the work done by the staffs of the superintendent of physical training and the army educational officer. It would lessen invaliding, and increase efficiency, by bridging this gap which I personally am convinced is harmful to all those who get into it, and would endeavour to return the soldier to his battalion physically fit for duty and mentally and morally improved.

From the above one would expect, and in fact it does happen that the convalescent depot, in peace, is the place where one finds the bad type of soldier, the lead-swinger, the mentally deficient, the mild neurasthenic, and the man of weaker moral fibre. One would be compensated for the failures or modified successes among this class by the results one should get among the debilitated young soldiers and the recruits brought below standard by their illnesses. Unfortunately it also seems to be a fact that the good types, the types one wants in a convalescent depot, prefer to go back direct to their units from hospital. This is of course a matter for the officer commanding the hospital to decide and insist on. I would lay stress on the necessity of this insistence.

That brings one to another factor in the question of possible success or failure of a convalescent depot in peace; the officers in medical charge of troops and in the hospitals will have to learn when, and how, the convalescent depot can help them in their care for the soldier.

I am one of those who believe, and in this, my friend Major Dinwiddy, Superintendent Physical Training, Egyptian Expeditionary Force, is with me, that a closer liaison between the medical officer and the physical training expert, and the fostering of the true sporting spirit among all ranks, will go a long way to solve many difficult and obvious questions of the present day soldier. A convalescent body and mind is one that should be the special study of the medical officer and a convalescent depot has that object in view.

The establishment allowed in Egypt is :—

- 1 Officer Commanding,
- 2 Medical Officers,
- 1 Adjutant,
- 1 Quartermaster,
- 1 Warrant Officer,
- 1 Quartermaster-serjeant,
- 3 Serjeants,
- 4 Corporals,
- 11 Privates,
- 7 Natives (sanitary personnel),
- 10 Natives, cooks and waiters.
- 4 Night Guards (Ghaffirs).

Discipline.—This is the most interesting subject in a convalescent depot. As stated previously, patients coming here are often not of the good moral type but in addition it is a fact that it is most often a convalescent spirit that inhabits the convalescent body. Each act of indiscipline must be studied as the act of a convalescent patient and the training back to normal made a special point of, not only by the officer but by the Royal Army Medical Corps company-serjeant-major and non-commissioned officers. Lectures are given to the officers and non-commissioned officers with the object of making them students of the mentality of the soldier they have to deal with.

There are many factors at play—away from regimental control, down for a loafing three weeks' holiday at the seaside, under the command of doctors, a man recovering from an illness is suffering also from weakening of the normal upper control over his lower centres, and therefore his reflexes—(which include his passion and temper reflexes)—are accentuated to a greater or lesser degree.

To apply indiscriminately or unthinkingly the big sticks of King's Regulations or Military Law to these cases is often a calamity to the man and his subsequent army career.

I do not mean that men should not be punished or that discipline in a convalescent depot should be relaxed. On the contrary, one must insist on obedience to instructions and suppress any tendency to vice with the firmest determination, but one must be far more subtle and considerate than with the fit man.

There is no "Montessori" method for this, and we must all be students as well as masters.

We have a detention ward to enable men to reflect on any advice they may have ignored. Men can be taken out of khaki and put in hospital blue. The canteen can be put out of bounds for them, passes can be curtailed, confinement to camp given in certain cases. The Army Act allows deprivation of pay, and one can withhold weekly payment if considered advisable and beneficial to the convalescent soldier. The Army Act is used, but only after careful thought, and with the convalescent depot's object in view—the physically and morally fit soldier.

Pay.—Pay was mentioned. I say right away that the convalescent soldier should not have his full regimental pay withheld: that is, the normally convalescing soldier. But if a man overstays his pass, stays out at night, gets drunk or likewise misbehaves himself, then the withholding of pay is one of the best medicines we have at our command.

Discipline and pay fit into each other in the jig-saw puzzle.

As an interesting case, so far, one may mention one of a few. A private in the best all round sporting unit in Egypt, who was an invalid to U.K. His weakness was for alcohol; nothing seemed to be able to stop him; confinement to camp he ignored; deprivation of pay he countered by selling sheets and anything he could lay his hand on. His mentality

110 *Convalescent Depot as a Permanent Peace Organization*

was studied. He had been deprived of altogether about six weeks' pay and had willingly submitted to personal charges for loss of kit of all kind. He was talked to and put into hospital blue. Next day he was gone again and two days later apprehended by the Military Police in khaki. He had apparently sold his blue, recovered his khaki in some way and lived on the proceeds for two days. He was then put into the detention ward, and there, with a shirt and with ample blanket warmth, he made many and ingenious efforts to obtain his freedom. By this time he was a wreck physically and mentally. Entirely out of condition and with a soaker's countenance and a chronic cough. He began to recover with alternate fatigue duty, rest in bed and suggestion, and always absence of alcohol. His face began to clear up, a smile came instead of a scowl when one said he was looking better. He asked to get more interesting jobs of work; and one month later he was as keen as mustard on getting back to his battalion and not being invalided. He had undergone all sorts of punishment which only seemed to make him worse and narrowly escaped court-martial. Some will say he ought to have had it. We disagree. The man is well under way to physical and moral recovery.

As amusements we have the N.A. and A.F.I., a St. George's hall with a cinema, which was started by a grant of £50 from Major-General Sir F. R. Newland, boating and seine-net fishing, billiard competitions, concerts, gardening and all the usual home games, etc., found so successful in a convalescent depot during the war.

We have a miniature air rifle range and a weekly pool prize and inter-section competitions. The air rifle is a B.S.A. air rifle No. 2 and is accurate up to fifty yards range. The men pay half a piastre for a target and seven pellets.

There are inter-section cups and an inter-company cup. With these we try to compete with the flesh-pots of Alexandria.

A sense of humour is essential in dealing with the British soldier.

The types of patients received and the reaction of certain types to treatment and average duration the patients stay in the depot, and some other statistical facts, we intend to submit when the summer wave of endemic illnesses is past.

Running through all will be three evil factors with which we have to contend.

(1) The poor type of soldier wants to come for a rest, the good type wants to go back to his unit when discharged from hospital.

(2) The proximity of a town of the Alexandria variety.

(3) Innate propensity of native employees to steal (and in which one regrets to say, they are often assisted by a type of British soldier) and the waste of energy required to cope with theft.

One anticipates many modifications and one hopes for many additions as one gains experience and these will be given in a subsequent report.

This convalescent depot is divided into two convalescent companies

"A" and "B," with Captain H. G. P. Armitage and Captain C. F. Burton, M.C., as company commanders.

It has accommodation for thirty officers and 500 other ranks and is almost self-supporting, as will be seen from the Royal Army Medical Corps establishment allowed.

A company commander's report on the administration of his company is now given.

The detail of guard duty and method of paying out, etc., are common to both companies and call for no particular description.

NOTES ON THE ADMINISTRATION AND AIMS OF A COMPANY IN A
CONVALESCENT DEPOT, BY CAPTAIN C. F. BURTON, M.C.

(1) *Administration.*

(a) *Constitution.*—The company was equipped for a minimum of 200 patients, sub-divided as far as possible into sections of eighteen.

Each section was accommodated in either a portion of a hut or in E.P.I.P. tents, and a convalescent non-commissioned officer placed in charge. The figure 18 as constituting a section was taken as the normal accommodation of three E.P.I.P. tents. Sections were numbered with the letter of the company from I to IX with separate sections for non-commissioned officers and company night duties.

A separate dining-hall was allotted to each company in which the sectional arrangement was maintained at tables, each seating eighteen men.

Attached to the company was a small "sick bay" of six beds, in which special cases were treated for forty-eight hours or less.

Latrines, recreation-hut, and dressing-room, as well as bathing and disinfecting arrangements, came under depot administration and were common to companies.

A company office was found necessary not only for the usual routine administration but also for record purposes.

(b) *Establishment.*—During the period under review the company was to all intents and purposes self-supporting, as the only permanent personnel available were the officer-commanding company and one serjeant Royal Army Medical Corps as wardmaster. The essential employments after three months' experience are tabulated in Appendix I. It must be understood that these employments were within the company only, and were in addition to details which had to be found from companies to supplement the permanent staff of the depot.

Employments within the company were changed weekly as far as numbers would admit.

Depot employments included guards, fire-pickets, storemen, and depot fatigues, and were as a rule detailed by companies in turn.

Employed convalescents were not excused recreational training. This was optional for guards.

112 *Convalescent Depot as a Permanent Peace Organization*

(c) *Routine*.—Companies received new arrivals for one week in rotation. The new arrival passing from the depot central admission and discharge department to the receiving company office, where all particulars including trade were registered, and thence to his section.

Bedding and hospital equipment according to scale was issued from store on day of arrival. Patients, as far as possible, were placed in No. 1 Section on admission, from which they graduated according to progress.

All new admissions were seen the day following arrival by the company officer, examined and categorized into one of the following :—

Category A.—New arrivals and patients in their first week. Excused all duties and recreational training. Not available for employment. The category included debilitated and anæmic patients until well enough for promotion to :—

Category B.—Patients in their second week and those capable of moderate exercise. Available for light duties and recreational training.

Category C.—Patients in the latest stages of convalescence fit for heavier exercises, guards, etc.

Category D.—Fit for discharge to duty.

The minimum stay under this scheme was three weeks and the average stay about five. It follows from what has been already said that, as a general rule, sections were made up of men of the same category, i.e., the higher the number of the section, the higher the category and vice versa.

This fact proved of use in the graduation of recreational training.

Categories were reviewed by the company commander twice weekly and altered or not according to progress. Two discharge days were fixed weekly—Wednesday and Friday.

Category C were considered for discharge on the previous Monday or Wednesday to allow especially for the notification of units concerned and the necessary depot arrangements as regards rations, railway warrants, etc., to be made.

The daily routine for the months in question, January to March, is detailed in Appendix II. Company standing orders which included this routine were read out to all new arrivals the day following admission, when the aims and special points of the depot were also explained.

(d) *Pay and Discipline*.—During the period under review patients in convalescent depot were paid according to the following scale :—

	Ptes.		Cpls.		Serjts.		W.O.s		
Non-employed	..	P.T. 25	..	P.T. 25	..	P.T. 25	..	P.T. 25	.. Weekly
Employed 50	..	.. 60	..	.. 75	..	.. 125	..

This system served to make employment and proper performance thereof a privilege, especially as passes were granted in a greater proportion to employed patients.

Although this may appear to penalize patients in category A—the

hardship entailed was not so severe as it would seem. The question of the payment of convalescent soldiers is one that is likely to give rise to controversy when it is considered that the wants and routine life of the convalescent soldier differ very little from those of the normal soldier, the regulation governing the pay of patients in hospital can hardly be said to apply. It has been proved by experience that a fixed weekly pay day and fixed amounts give better results than intermittent and varying payments at the discretion of the units concerned.

Discipline in a company of men drawn from so many different units proved to be one of the greatest problems of the officer commanding the company, chiefly because he had to depend almost entirely on non-commissioned officers from amongst the patients themselves. The impression that regimental discipline ceases on admission to a medical unit was unfortunately noticeable not only amongst the young soldiers but also amongst the younger non-commissioned officers.

The company commander was invested with the powers of a company officer.

Recreational training, provided the strictest discipline was insisted upon, proved of great value in introducing some degree of *esprit de corps* and moral amongst the men.

Passes were granted at the discretion of the officer commanding the company from 14.00 hours to 20.00 hours.

(e) *Medical Treatment, Feeding, and Recreational Training.*—As decided recently by the authorities, only those cases requiring the minimum of medical treatment were to be chosen for transfer to a convalescent depot. This decision appears to have been justified, as medical treatment beyond tonics would undoubtedly interfere with the desired routine, and so with the desired result.

Roughly speaking, transfers received during the months in question resolved themselves into two main groups:—

(1) *Medical.*—Including debility following malarial fever, typhoid fever, dysentery, and pyrexia of unknown origin, subacute gastric conditions and diarrhoea, anæmias and D.A.H.'s—the latter as a supervening disease.

(2) *Surgical.*—Including post-operative debility and large proportion of semi-cured injuries, chiefly of the joints. Healed septic conditions.

Of the medical group, a large majority showed a concurrent affection of the heart, usually temporary, but of far greater importance from the convalescent point of view than the original disease.

Among the surgical group the post-operative cases appear to give the most satisfactory response to graduated exercise.

On the primary medical examination the weight and general condition of all admissions were noted in those cases in which the heart was found to be affected, special attention was paid to the pulse-rate and exercise tolerance and these cases were carefully watched during progress.

The sick-bay was in most constant demand for the recurrent malaria

114 *Convalescent Depot as a Permanent Peace Organization*

case, who as a general rule was able to be replaced in category A after forty-eight hours. Normally no case requiring more than forty-eight hours in the sick-bay was retained in the depot.

Treatment resolved itself into tonics, oil and malt, quinine and those minor dressings which would not prevent a patient continuing the ordinary routine of his category.

Feeding.—Up to the time of writing, a convalescent depot has been considered as a dieted hospital in which patients on ordinary diet draw a hospital ration with any extras that may be ordered. From the experience gained, the normal hospital diet appears to meet the case; with the exception of fresh vegetables and bread, both of which were increased as dining-hall extras.

As patients were permitted to use the canteen, the question of allowing the purchase of beer to certain classes had to be considered. It was not found advisable to allow alcohol to such cases as malarias, young soldiers with so-called D.A.H., or cases in which the digestive system was affected. To control the issue of alcohol at the depot canteen, A.F. I 1220 of each patient was marked according to whether he was allowed alcohol or not. A record was kept under charge of the non-commissioned officer in charge of the canteen.

This system was by no means infallible as certain types of men obtained this alcohol in spite of precautions.

The issue of soup, bread and jam, or cheese at the evening meal, was found to be popular. Cocoa in lieu of soup was tried but without great success.

Recreational Training.—It is difficult to speak of results under this heading, as the system evolved has not yet had a fair trial. Taking into consideration the average young soldier's inherent mistrust of physical training, a scheme of organized recreational games was instituted. This was divided into two groups, A and B, with the object of making the exercise involved progressive.

A group comprised a section of lighter games as laid down in recreational training, the weekly programme used is attached in Appendix III.

Group A was confined to men of Nos. 1, 2 and 3 sections, excluding categories A, unless voluntary and sanctioned by the medical officer.

Group B contained the higher sections, each group being under the instruction of a trained non-commissioned officer, the whole under the personal supervision of the company commander.

Games were played to time-table (Appendix III), allowing as a rule three minutes exercise to two minutes rest.

Special cases, i.e., heart affection and joint cases, were watched and moved from one group to another when necessary without letting the patient know the reason for the move.

A strict attention was paid to discipline during games and the maintenance of sections so as to foster the spirit of competition. With this

object in view, an intersectional cup was presented weekly for the best all round section in the company and an intercompany cup once monthly.

Not the least important part of convalescent training proved to be healthy occupation of the mind by cinemas, concerts, books, and a fully-equipped recreation-room.

It was found at the beginning that, with a certain type of young soldier it was with the greatest difficulty that he could be persuaded to leave his hut or tent during the best hours of the day. The weather during the months of January to March did not allow of the benefit of sea-bathing.

(2) Aims.

(1) To cover the latent period between sickness and health in the most profitable way.

(2) To insure medical supervision of the soldier during this period.

(3) To reduce wastage and unnecessary invaliding.

These objects appear to be easily obtainable, but from the company point of view, as long as the best type of young soldier is allowed to return to duty on discharge from hospital, and the bad type sent to convalescent depot, the work of the company must suffer.

The fact that during the past three months an average of one-third of the company was employed on necessary duties which interfered with training, must of necessity have militated against results.

APPENDIX I.—EMPLOYMENT OF PATIENTS WITHIN THE COMPANY.

Nature	Period	N.C.O.s	Other ranks		Remarks
Company Orderly Serjeant ..	7 days	1	—	A.G.	—
In charge of Company Messing ..	21 "	1	—	A.G.	Supervision of cleanliness and serving food
Medical Officer's Orderly ..	21 "	—	1	A.G.	—
Company Clerks ..	21 "	1	1	N.A.G.	Records, details, orders
" sanitary details ..	7 "	1	4	A.G.	Supervise native labour
Section Commanders ..	7 "	As required	—	A.G.	—
" Orderly Men ..	7 "	As required	—	N.A.G.	Safeguarding personal and public equipment
N.C.O. in charge of Game Group	21 "	2	—	A.G.	Instructions
Dining Hall Orderlies ..	7 "	—	2	N.A.G.	Dining hall fatigues
Game Orderlies ..	21 "	—	2	A.G.	Care of playing ground and material

Note.—A.G. : Available for games.

N.A.G. : Not available for games.

Depot employment to be found alternately by Companies every 7 or 21 days.

N.C.O.s ..	..	..	..	..	5
Other ranks ..	..	..	..	..	44

116 *Convalescent Depot as a Permanent Peace Organization*

APPENDIX II.—DAILY ROUTINE COMPANY, JANUARY TO MARCH, 1921.

Réveillé	6.30 hours
Roll Call	7.00 "
Breakfast	7.45 "
Medical Officer's inspection	8.30 "
Skin inspection	8.30 " (Monday)
Quinine Parade	8.40 "
Company Orderly Room	8.45 "
Sick Parade	9.00 "
Fall in	10.25 "
Recreational training	10.30 " to 11.30 hours
Dinner	12.15 hours
Voluntary games	14.00 "
Intersection competition	15.30 "
Tea	16.00 "
Supper	18.00 "
Roll Call	21.30 "
Lights out	22.00 "

Officer Commanding, Depot Inspection, 11 a.m., Monday.
Bathing Parade: Sundays and Wednesdays.

APPENDIX III.

Day	Group A	Group B	Remarks
	A, A1, A2	A3, etc.	
Monday	Relay Race, Overhead .. Under and side passing .. Maze Whip to the Gap	Basket Ball Wrestling for Pegs — —	No single game in Group A will last more than three or four minutes without a rest
Tuesday	Into the Ring Jump Ball Circle touch Ball Number Race	Wrestling Tug o'War King of the Island —	
Wednesday	Jumping the Bag Pulling over the Boundary Crows and Cranes Dodge Ball	Basket Ball Medicine Ball Fox and Goose —	
Thursday	Relay Race (as Monday).. Changing Places Maze Jump Ball	Jump Ball Basket Ball Running Relays. —	
Friday	Circle touch Ball Into the Ring Number Race Whip to the Gap	Boxing and Wrestling — — —	
Saturday	Jumping the Bag Crows and Cranes Dodge Ball Maze	Basket Ball Medicine Ball Fox and Goose —	

THE BOTANY AND NATURAL HISTORY OF THE DYKE-LAND,
NEAR SANDWICH, KENT, AS FAR AS THEY CONCERN
MEDICAL ENTOMOLOGY.

By MAJOR J. E. M. BOYD.

Royal Army Medical Corps.

Officer in Charge, War Office Entomological Laboratory, Sandwich.

(Concluded from p. 47.)

Anopheles bifurcatus.

Not many adults of these have been caught. The largest number brought in was thirty-one females on October 8. During this month seventy-eight were caught, all females, only one male has been seen, and that was bred out from larvæ in the laboratory; this was placed in the breeding cage and later about a dozen ova were laid. These hatched out but died in the larval stage.

Larvæ.—These may be distinguished from the larvæ of *A. maculipennis* by the fact that the outer anterior clypeal hairs are not branched. The adults, not being so domesticated in their habits as *A. maculipennis*, their larvæ are usually found further afield than the larvæ of the latter. The dyke in which the greatest number is found has the banks overgrown with weeds and is almost stagnant in parts. The bottom is covered with leaves and decaying vegetation, into which the larvæ appear to burrow at times.

This corresponds with the description of Macdonald, but Feytaud and Gendre of Bordeaux state that "*A. bifurcatus* prefers pure cold, running, often renewed water" (*Procès verb. Soc. Lin. Bordeaux*, lxxi, 1919).

Condition of Dyke and Analysis of Water from which larvæ of A. bifurcatus were taken May 1, 1921.—Depth of dyke about five inches; banks overgrown with weeds and badly looked after; *Entomorphia intestinalis* growing in the water; dyke stagnant in parts; bottom, soft mud and debris of decomposing vegetable matter, temperature of water 42·8 F.

Report on the Water, by Colonel Lelean, Professor of Hygiene, Royal Army Medical College.—The water was slightly yellow, with a black muddy sediment.

The water was alkaline to litmus, and the presence of poisonous metals could not be detected.

The results of the chemical analysis were as follows:—

Ammonia, free and saline ..	..	..	..	0·122	part per 100,000
" albuminoid ..	..	..	..	0·114	" " "
Chlorine present as chlorides ..	..	..	..	41·2	parts " "

Though not actually brackish, the percentage of salt in this water is rather high.

This mosquito passes the winter in the larval stage and does not appear to be affected by cold. Larvæ have been obtained here during December in the water of a dyke which had completely frozen over.

Culex pipiens.

Adult females may be found throughout the year, as they hibernate in this stage. The first egg-rafts were found on April 15 in a tank at the sewage works. No water appears too foul for this species to breed in.

As has been mentioned before, males were noticed swarming with male *A. maculipennis*. It was suggested that a "blood feed" was not necessary for the females of this species, prior to ovipositing. On August 2, about 1,000 of each sex, newly emerged, were placed in a large breeding cage and were given a diet of banana, glucose and water. No ova were deposited during the time they survived. The longest length of life recorded here was for males fifty-one days and for females 163 days.

On August 5 a male *Aedes calopus* was seen in copula with a female *C. pipiens*—nothing resulted.

Life History of C. pipiens, as worked out here; average temperature 65° F.

Egg rafts collected	..	August	9, 1920	..	—
Hatched	..	"	10, 1920	..	1 day
Pupated	..	September	2, 1920	..	23 days
Emerged	..	"	5, 1920	..	26 "

Drying experiments with *Culex* ova, larvæ and pupæ.—Ova: Egg rafts were placed on filter paper and allowed to dry, afterwards were placed on dry filter paper in Petri dishes, water being added after varying periods.

3 days	..	..	..	..	A few larvæ emerged
4 "	..	..	..	..	"
6 "	..	..	..	..	No larvæ emerged
8 "	..	..	..	..	"
10 "	..	..	..	..	"

Larvæ and pupæ treated in the same way as ova.

		Larvæ		Pupæ		Remarks
3 hours	..	Active	..	Active	..	1 larva pupated
4 "	..	"	..	"	..	
5 "	..	"	..	"	..	1 pupa emerged
24 "	..	Dead	..	"	..	
48 "	..	"	..	Dead	..	

Theobaldia annulata.

Adult females of these are found throughout the year. It is stated that only females hibernate, but this is still an open question, as larvæ and pupæ have been found in the dykes up to the date of writing (January 14, 1921), together with cast pupal cases, from which the adults have emerged. Pupæ kept in the laboratory have produced specimens of both sexes in almost equal numbers, so there is no reason to suppose that males do not also emerge in the wild state; this investigation is being continued.

On December 13 eighteen degrees of frost were recorded here; larvæ and pupæ of *T. annulata* were found in the dykes, which were frozen

over; others were again found on December 15, 16, and 20. During the cold weather the pupæ appeared torpid, some were dead, but the former rapidly recovered when placed in the warm room and emerged normally.

On one occasion (January 20, 1921), the larva of *T. annulata* was seen feeding on the roots of azolla, hanging vertically in the water with its head uppermost.

It was proved on January 24, 1921, that males do emerge during the winter months. An egg raft and some newly emerged larvæ were found also on this date and more young larvæ on January 25, 1921.

The larvæ live in the same dyke as *A. bifurcatus*, of which an analysis has been given. They will also live in water which is foul, but not so foul as that in which the larvæ of *C. pipiens* will live.

Theobaldia (Culicella) fumipennis.

Only a few of these were caught, as adults; some larvæ and pupæ were found in April. This species does not appear to be very common in this district.

Theobaldia (Culicella) morsitans.

A collection of larvæ of this species was made on January 28 of this year, this being the only occasion on which I have seen them here.

Ochlerotatus rusticus.

Specimens were collected on January 28 from the sewage farm, on the Sandwich Bay road; included in the collection were some larvæ of *T. annulata*; others were thought to belong to some species of *Culicella*; to make certain some were sent to Mr. F. W. Edwards, British Museum (N.H.), with a request that he would kindly identify them for me. His reply was as follows:—

“The larvæ you sent are mostly *T. (Culicella) morsitans*, and are about the size I should expect to find them at this time of the year. I found last year that they did not become fully grown until April.

“Mixed with this species are a number of examples of *O. rusticus*, and this is somewhat more surprising since they are not generally supposed to hatch from the egg till the early spring. The biology of *O. rusticus*, however, is not yet fully worked out, and it may be that like *O. geniculatus* it may overwinter either as egg or as larva. Martini records finding nearly full-grown larvæ at the beginning of March.

“Your finding of an egg-raft of *T. annulata* quite recently is very interesting.”

KILLING EXPERIMENTS.

Many experiments for the destruction of anopheline and culicine larvæ and pupæ were carried out during the summer months. Some of them are mentioned below.

120 *The Botany and Natural History of the Dyke-land*

(1) Tuba root, $\frac{1}{2}$ oz. (of the dried root); water, 1 quart	All dead in 24 hours
(2) Flaked naphthalene, $\frac{1}{2}$ oz.; water, 1 quart (a complete layer of crystals was made over the water)	Killed rapidly
(3) Metallic copper, 200 grm.; dyke water, 20,000 c.c.	No ill effects, even after long standing
(4) Cresol, 10 c.c.; dyke water, 20,000 c.c. ..	Larvæ killed in 90 minutes
(5) Cresol, 1 in 1,000	Larvæ killed in 3 minutes; pupæ in 1 hour 45 minutes
(6) Cresol, 1 in 10,000	Larvæ killed in 15 minutes; pupæ in 4 to 8 hours
(7) Cresol, 1 in 100,000	Larvæ killed in 1 hour; pupæ alive in 3 days
(8) Cresol, 1 in 250,000	No ill effects
(9) Cresol, 1 in 500,000	No ill effects
(10) Aluminium fluoride, 20 grm.; dyke water, 20,000 c.c.	No ill effects
(11) Peat, 200 grm.; dyke water, 20,000 c.c. ..	An excellent solution for breeding purposes
(12) Metallic iron, 200 grm.; dyke water, 20,000 c.c.	No ill effects, even after long standing
(13) Paraffin oil, $\frac{1}{2}$ oz.; water, 1 quart (mixed with the water)	Larvæ all dead in 2 hours; pupæ alive in 3 days
(14) Paraffin oil, $\frac{1}{2}$ oz.; water, 1 quart (as a film)	Larvæ killed in 3 hours; pupæ killed in 45 minutes
(15) "Milton," 5 per cent	Many larvæ dead in $4\frac{1}{2}$ hours; pupæ active
(16) "Milton," 5 per cent	Many larvæ dead in 6 hours; pupæ active and emerged
(17) "Milton," 10 per cent.. .. .	All larvæ dead in $4\frac{1}{2}$ hours; pupæ active, but died later
(18) "Milton," 15 per cent.. .. .	Larvæ killed in 3 hours; pupæ: some killed; others emerged, but died soon after
(19) "Milton," 25 per cent.. .. .	All animal and vegetable life destroyed in 45 minutes
(20) Saline, $\frac{1}{2}$ per cent	Larvæ and pupæ lived and became adults
(21) Saline, 1 per cent	Larvæ and pupæ lived and became adults
(22) Saline, 2 per cent	Fatal to both larvæ and pupæ

(Nos. 8 and 9 would have been repeated, as I do not consider the results satisfactory, but the cresol supply gave out.)

The Muscidæ family is the next of importance, including as it does *Musca domestica* (the house-fly), *Calliphora erythrocephala* (the blue bottle), *Lucilia cæsar* (the green-bottle) and others.

Musca domestica (the house-fly).

It had been hoped to carry out experiments, on a large scale, for the destruction of this species, but for several reasons nothing of much value could be done. The chief reasons being:—

(a) The laboratory, situated as it is, about a mile from the town, in an open position, was not much visited by this species. It was not until May 14, that a specimen was caught in the laboratory.

(b) Horse manure, for breeding purposes, could not be obtained locally, as the farmers needed all they had, for their land; a truck load was received from the Royal Army Service Corps at Dover, on arrival this was found to be old and stale, and quite unsuited for the work in hand. Many attempts were made to induce flies to oviposit in the heaps of manure without result. Human fæces, urine, fresh cowdung, and weak solutions of ammonia were tried at various times, but not one of these proved to be of use.

(c) The weather was also against any satisfactory results, outdoor experiments of all kinds being frequently spoiled by rain. To get sufficient flies for killing experiments, fly traps were bought and distributed amongst the butchers and fishmongers in the town, the traps being collected when required, by an orderly. The captures were varied, but the most common species were *Musca*, *Lucilia*, *Calliphora*, *Pollenia* and *Phormia*, so that most of the killing experiments were carried out with a mixture of these species. Though unable to work out the life history locally, I was able to do so at my home a few miles away; it was as follows:—

Ova laid, and hatched next day. First moult, second day; second moult, fourth day; pupated, ninth day; adults emerged, fifteenth day.

The eggs were laid in batches of 100 to 150, and measured about one millimetre in length.

Copulation was observed to last from a few seconds up to one hour twenty-five minutes. Ova are laid about five to seven days after copulation. Sexual maturity is reached from ten to fourteen days after emergence from the pupa. Several specimens were placed in a cage, at a temperature of 70° F., without food or water, all were dead in four days. Empusa, a fungoid disease, claims many victims, and appears to be very fatal. During the cold spell, in August, I noticed at home, that there were many dead flies on the walls and ceiling of the kitchen. On the 24th, I counted twenty-three dead and sixty living flies, and on the 26th, I saw twenty-five dead and fifty-five living. On the 29th, two pairs were caught in copulo, and were placed in tubes for removal to the laboratory next morning, but on looking at them next day three of them had died of empusa disease during the night. When first affected, the fly appears sluggish in its movements, the abdomen gradually swells and death ensues. The legs are often widely spread out, with the proboscis protruded and sticking to the wall or ceiling. Under a low magnification the spores of the fungus are readily seen. A patch of fungus often surrounds the dead fly, on the wall. (A very good illustration of this is given in "Flies and Disease, Non-blood-sucking Flies," Cambridge Public Health Series, by Dr. Graham Smith, plate xxiv, p. 230).

As most of the killing experiments were carried out with mixed species, it may be well to leave a description of these until the other members of this group have been described.

Calliphora erythrocephala (the blue-bottle).

Many hundreds of these were bred from ova deposited on stale fish. The breeding was at first carried out in one of the rooms in the laboratory, but the smell was so unpleasant that everything had to be moved to an open shed, where the life history was worked out. The weather at the time was cold and wet, but the following data were obtained:—

Ova laid on stale fish; ova hatched next day. First moult, third day

(from date of egg) ; second moult, fifth day ; pupated, twelfth day ; adults emerged, twenty-ninth day.

The size of the adults varies with the amount of food given to the larvæ, if partly starved the resulting adults are small. The average size for adults was : span of wings twenty-five millimetres ; length of adults twelve millimetres.

The ova measure from 1.4 to 1.5 millimetres in length and are laid in batches of 450 to 600.

When ovipositing the female takes up a position with the legs spread out ; the ovipositor is extruded, the eggs being laid one at a time in masses at intervals of three to thirty seconds.

The larvæ are very active, and have been seen climbing to the height of nearly two feet up a wall of smooth cement. The rate of movement on a flat surface, was measured and proved to be seventy-nine millimetres in ten seconds.

Measurements were taken of one hundred pupæ, these gave the following averages : Large pupæ, 10 by 4 millimetres ; small pupæ, 8 by 3.5 millimetres. Weights : Large pupæ, 0.07 gramme ; small pupæ, 0.047 gramme.

The emergence of the adult stage from the pupal is of interest to watch. The first thing noticed is a small semi-circular crack, near the end of the pupal case, the ptilinum shows almost at once in this crack, and gradually pushes back the end of the pupal case, until the latter is either completely pushed off or is hinged back.

The head then gradually appears, the ptilinum continuing to expand and contract until almost the whole fly has emerged. Sometimes a condition resembling the human " breech presentation " occurs, the fly trying to emerge tail first, five of these were seen in one batch of about 1,000 pupæ, so evidently the condition is not common nor have I seen it mentioned in any book on entomology. Of the five seen, one emerged safely. One failed to do so in over four hours, the three remaining were killed and mounted as specimens.

The ptilinum still retains its action even after the fly has completely emerged, flies were frequently seen to be making use of it in their attempts to escape from Petri dishes or from tubes plugged with cotton wool.

The time taken to emerge, by a timed specimen was as follows :—

From the appearance of the crack until completely emerged	..	7 minutes
Wings half grown, body darkening	.. .. .	10 "
Wings fully developed	.. .. .	20 "
Remained stationary in a vertical position, thorax darker than abdomen	.. .. .	60 "
Flew weakly when disturbed	.. .. .	65 "
Flew well	.. .. .	80 "
Appeared normal in all respects	.. .. .	95 "

When first emerged the body is greyish in colour, but gradually becomes darker as the outer chitinous coat hardens. Some newly laid ova were

placed in a jar which contained only the dead bodies of adult *Calliphora*, they hatched on June 17, and living adults emerged on July 21 and 22.

The larvæ and pupæ are unable to withstand high temperatures for any prolonged period, all were killed when exposed to a temperature of 57° C. in fifteen minutes.

Regarding the effect of removing all food and water, adults were all dead, at 60° F. in forty-eight hours.

Larvæ and pupæ are able to withstand immersion in water for a considerable period. A series of experiments were carried out to determine this period.

(A) When completely immersed in an inverted tube full of water.

(B) In a partly filled tube, which was uncorked.

The results were as follows:—

DATE OF COMMENCING THE EXPERIMENTS, JUNE 25.

Series (A).					
½ hour	..	Larvæ active	..	..	..
					Pupæ emerged on July 9
					Larvæ 19
1	..	..	..	..	Pupæ 9
					Larvæ 19
2 hours	..	2 larvæ immobile, but recovered			Pupæ 10
					Larvæ 19
3	..	Larvæ inactive	..	..	Pupæ 9
					Larvæ 20
4	..	..	..	..	Pupæ 9
					Larvæ 20
19	..	..	..	..	Pupæ 10
					Larvæ did not emerge
24	..	..	..	..	Pupæ emerged on July 10
					Larvæ did not emerge
48	..	..	..	..	Neither pupæ nor larvæ emerged
Series (B).					
½ hour	..	Larvæ active	..	..	..
					Pupæ emerged on July 9
					Larvæ 19
1	..	..	..	..	Pupæ 9
					Larvæ 19
2 hours	..	..	..	..	Pupæ 10
					Larvæ 19
3	..	.. inactive	..	..	Pupæ 9
					Larvæ 20
4	..	..	..	..	Pupæ 9
					Larvæ 20
19	..	.. 2 active	..	..	Pupæ 10
					Larvæ 21
24	..	.. inactive	..	..	Pupæ 10
					Larvæ did not emerge
48	..	..	..	..	Neither pupæ nor larvæ emerged
Control	..	—	..	..	Pupæ emerged on July 9
					Larvæ 19

Nothing need be said concerning *Lucilia*, *Phormia* and *Pollenia*, except that specimens of these were caught, together with *Musca domestica* and *Calliphora*, in the fly traps in the town, and that they were used in the killing experiments, to be described later.

Stomoxys calcitrans.

Many of these were caught in the farmyards and also in the laboratory; they appear to be more common in the camp than *M. domestica*.

Some adults were placed in a jar containing sterilized bran; the latter was heated to a high temperature in order to destroy any fungus that might have been present; one or two of the females oviposited in the bran, which was kept moist by the addition of boiled water when necessary.

The life history, as worked out, was as follows:—

Flies placed in the bran	..	..	..	October	25, 1920
Ova laid	..	..	..	..	29, 1920
Ova hatched	..	..	..	..	30, 1920
First pupa seen	..	..	..	November	16, 1920
First adult emerged	..	..	..	..	25, 1920

Other adults emerged on the following day; many larvæ and pupæ were also still remaining, but all were killed in order that they might be mounted as specimens for demonstration. Except that they were smaller than specimens caught in the wild state, these did not differ from the latter in any way. The mean temperature during the experiment was 65° F.

Fannia canicularis (the lesser house-fly).

Specimens of this species, which belongs to the Anthomyidæ, were caught with *M. domestica* in the traps, and were common. This species is of interest; it may cause myiasis in man.

Hydrotea dentipes.

This species also belongs to the Anthomyidæ, and is of interest as the larvæ are known to eat the larvæ of *M. domestica*.

Killing experiments with species of Muscidæ and Anthomyidæ.

The effects of the following drugs were tested:—

(i) Formalin vapour:—

Formaldehyde 40 per cent.	..	..	..	..	20 c.c.
Potassium permanganate	..	..	..	..	8 gm.

for each 1,000 cubic feet; the permanganate should be powdered before use. This acts well.

(ii) Formalin, in solution:—

Formaldehyde 40 per cent.	..	..	..	..	10 per cent.
Lime water	..	..	..	..	50 "
Sugar..	..	..	..	..	2 "
Water to	..	..	..	..	100 "

This solution gave very good results.

The following were added to a solution of treacle and water:—

(iii) Sodium arsenite ten per cent. First fly was dead in thirty minutes, all were dead in twenty-four hours.

(iv) Sodium iodate about two to five per cent. All were dead in two days.

(v) Sodium fluoride about two to five per cent. All were dead in thirty-six hours.

(vi) Ammonium fluoride ten per cent. First fly dead in forty-five minutes, all dead in less than twenty-four hours.

(vii) Potassium fluoride about two to five per cent. All dead in twenty-four hours.

(viii) Potassium iodate about two to five per cent. All dead in thirty-six hours.

(ix) Copper acetate about two to five per cent. All dead in two days.

(x) Betanaphthalene apparently useless.

Control, alive after three days.

Of the above, formalin solution is considered to be the best for indoor use, and sodium arsenite for manure heaps, etc. The latter, being very poisonous, should be kept away from children and food.

Ammonium fluoride is also suitable for outdoor use and is not so poisonous as the sodium salt.

A full list of the Diptera caught locally, during the period under consideration, is as mentioned below.

Orthorrapha.

Nematocera.

Tipulidæ ("Daddy Long-legs").

Ryphidæ.

Cecidomyidæ.

Chironomidæ.

Psychodidæ (Midges).

Culicidæ (Mosquitoes, including *Culex pipiens*, *Anopheles maculipennis*, *Anopheles bifurcatus*, *Theobaldia annulata*, *Culicella morsitans*, *Culicella fumipennis* and *Ochlerotatus rusticus*).

Mycetophilidæ.

Bibionidæ.

Brachycera.

Tabanidæ (including *Hematopota crassicornis*, of which the males were found on fences, and the females "attacking." *Chrysops relictæ*, the males being found on thistle flowers and the females "attacking").

Stratiomyidæ.

Leptidæ.

Phoridæ.

Empididæ.

Asilidæ (of importance on account of their preying on other flies.

One specimen of *Leptogaster* was caught at Birchington; this had two anterior cross veins on one wing, and was sent to the British Museum for inclusion in the collection).

Therevidæ.

Lonchopteridæ.

Dolichopodidæ.

Cyclorrapha.

Aschiza.

Syrphidæ (including *Eristalis*, the "rat-tailed" larva of which may cause myiasis in man).

Schizophora (Acalypteræ).

Phycodromidæ.

Cordyluridæ (some species of these, the Scatophaga, are predaceous on *Musca domestica* and other flies).

Sepsidæ.

Helomyzidæ.

Conoptidæ.

Sapromyzidæ.

Borboridæ.

Ephyridæ.

Drosophilidæ.

Agromyzidæ.

Geomyzidæ.

Trypetidæ.

Psilidæ.

Schizophora (Calypteræ).

Tachinidæ.

Sarcophagidæ (flesh flies).

Muscidæ (includes *Musca domestica*, etc.).

Anthomyidæ (includes *Fannia canicularis*).

Pupipara.

Hippoboscidæ (*Melophagus ovinis* is the only species found here and can be obtained from sheep, especially when shearing is in progress).

(2) The second order with which we are concerned, in Group A, is that of the Siphonoptera or fleas.

The following species have been obtained locally from various sources :—

Pulex irritans. Man and dogs.

Ceratophyllus fasciatus. Rats and stoat.

Ceratophyllus garei. Nests of meadow pipit, lark, sparrow, black-bird and starling.

Ctenocephalus canis. Dog.

Archeopsylla erinacei. Hedgehogs.

Ctenophthalmus agyrtes. Field mice.

Ctenophthalmus bisectodentatus. Moles.

The larvæ and pupæ, the latter in cocoons, of *Pulex irritans* and *Ceratophyllus garei* have also been found.

Endeavours were made to rear *P. irritans*; a few ova were obtained but the larvæ died.

One point of interest regarding fleas is the rapidity with which the adult can emerge from the cocoon, in which they undoubtedly lie quiescent until they consider that they should emerge. Two cocoons of *C. garei* were cleared in cedar-wood oil; the adult fleas could easily be seen inside the cocoon, together with the cast larval and pupal skins. Fleas will over-feed and when so doing pass undigested blood per rectum.

(3) The next order, in Group A, to be considered is the Anoplura or lice.

Pediculus humanus (the human louse).

Since it is easy to prove that *P. vestimentorum* will cross with *P. capitis*, it is well to look on each of these as a sub-species; the two can then be described under the heading *P. humanus*. Large numbers of these were obtainable at one time from an old tramp, but he died suddenly, just as the orderly in charge of the stock boxes, thinking he could easily obtain more, had given away the whole stock for experimental work, whilst he was up in London, at the Royal Army Medical College.

Since then very few have been obtained, in spite of the fact that tubes have been sent to all the neighbouring workhouses. Another tramp has recently been "located," but he refuses to come near the laboratory, in spite of the offer of bribes, as he says "I do not want to be disinfected." Under persuasion, he was on one occasion induced to remove his neckcloth by the roadside, but refused, owing to the cold, to take off his shirt: the neckcloth supplied one *Cimex lectularius* and two *Pediculi humanus*. His clothing should prove most interesting for entomological study and it is hoped that, even yet he may be induced to visit the laboratory. He spent the recent cold weather in the workhouse, so perhaps it may be well to allow his companions to increase and multiply, for a short time before examination. It really appears, at times, as if tramps have a liking for lice and other vermin.

The life history of the louse has been worked out as follows, at body temperatures :

Ova are laid two to four days after the female reaches maturity.

Number of ova laid is about 120, but as many as 295 have been recorded.

Number of ova laid in one day may reach ten with unrestricted feeding.

Ova hatch in from seven to ten days.

Larvæ moult three times : First moult third to fifth day after hatching, most on fifth day ; second moult seventh to ninth day after hatching, most on eighth day ; third moult tenth to fourteenth day after hatching, most on twelfth day.

Copulation takes place soon after the last moult ; the female has been observed in copulo, whilst still soft after moulting, but the male has to wait a few hours, until his chitinous covering has hardened.

Record length of life : Male thirty-two days. Female forty-six days.

Ova laid in stored clothing or bedding will hatch after five weeks. The best temperature at which to keep lice, for breeding purposes, is that of the body. The rate of development varies in accordance with the temperature and food supply. I carried stock boxes, in a bag round my neck, day and night for five months and at the end of that period they were still full of lice in all stages ; it is necessary however to clean out the boxes at least once in ten days, otherwise they become over-crowded, this may lead to the stock dying off.

The lice should be fed at least three times a day, twenty-five minutes being allowed for each meal. A pair of lice was kept, at body temperature

and fed as above, the female laid 4, 6, 7, 7, 7, 4 eggs on consecutive days ; unfortunately she then died.

The ova when first laid are opalescent, but become cloudy as the contents develop ; in the later stages the larvæ may easily be seen inside the ova, the eyes being conspicuous as small black dots.

Hatched ova are white and open at one end.

Ova are destroyed by exposure to a temperature of 60° C. for fifteen minutes or 55° C. for thirty minutes. They will survive immersion in water for several days.

Newly hatched larvæ have the appearance of adults, except that they are smaller and sexless.

It is of interest to take a newly-hatched larva and place it on the back of the hand—it will feed readily and under a low magnification the blood may be seen as it is sucked up and passed through the fore-gut to the stomach. The action of the sucking apparatus appears to be that of a small pump. Newly hatched larvæ must be fed within twenty-four hours of emergence, otherwise they will die.

Regarding adults, little need be said, except that virgin females will oviposit, but the ova are infertile. An excess of males leads to a decrease of ova ; one male has been proved to have fertilized twelve females ; Bacot states that eighteen out of twenty-one females were fertilized by one male. Renewed pairing is essential for a good supply of ova. Irregular feeding leads to gorging and death.

Adults and larvæ are killed by the same temperatures as ova. The best method for the destruction of all stages, is by the application of either heat or steam, in such a way as to ensure that the temperature is brought above or up to those already given, viz., 55° C. for thirty minutes or 60° C. for fifteen minutes. Clothing should be loosely packed and not tied up in tight bundles, blankets should be hung up, in the disinfecter. In the tropics the heat of the direct rays of the sun is often sufficient to destroy both adults, larvæ and ova. Ironing with hot irons is also a satisfactory method, but care must be taken that the irons are not so hot as to damage the material. Ants will remove lice, but it is not advisable to employ white ants ; in this case the clothing in addition to the lice may be destroyed.

A good preparation, suggested by Mr. Bacot, of the Lister Institute, is made by mixing crude unwhisked naphthalene with soft soap ; this should on no account be heated, as if it is the naphthalene will crystalize out. "Para-Quit," a preparation made by Messrs. Lawson and Co., is also useful.

(4) The fourth group to be considered is that of the Rhynchota or bugs. Several species of the plant bugs were obtained when out sweeping the grass for diptera, but these need not be considered here, the only species with which we are concerned being *C. lectularius*.

A small supply of these was obtained from Canterbury, on May 17, from a mattress bought at an auction, by an officer ; four of these are still alive : another was obtained from a tramp's neck-cloth. A few ova were deposited by these and hatched out in the laboratory, one larva is

also alive. One or two points of interest have been noticed, firstly that the larvæ will moult after one feed of blood and do not need two or three such feeds, as is usually stated. Secondly that the irritation caused by the bites, has been found, by personal experience, to commence about twenty-four hours after the bite has been inflicted, and persists usually for about two days. This is of importance to travellers and others using temporary quarters, it is of no use to accuse the hotel manager of having his beds infested with bugs, when the bites may have been inflicted the day before at another hotel. I could not feel the actual bite when the bugs commenced feeding, nor was any irritation felt until the next day.

Recently a male was seen to copulate with a female, whilst she was feeding; the latter appeared to treat the whole process with indifference and continued her meal; the male took up his position on the back of the female, lying rather obliquely to the long axis, on the right side. The process lasted about forty-five seconds. At the same time another female took up her position in the centre of the feeding area, the back of my wrist, and performed a strange form of "dance"; fixing her hind legs she jerked her head and thorax violently from side to side, for about four and a half minutes. No reason could be ascertained for this strange behaviour on her part; it may have been an attempt to attract the male or an outburst of passion at being slighted by him.

Bugs, when feeding, have not been seen to excrete blood nor have any returned for a second feed, when once they have withdrawn the proboscis, though they are described as doing so.

The time taken in feeding is four to five minutes; once the proboscis has been inserted into the skin, the bug remains still and does not move away until a full meal has been taken, it then withdraws its proboscis and tries to find cover.

Numerous water bugs have been found in the dykes, including amongst others *Nepa cinerea* (the water scorpion), *Notonecta glauca* (the water boatman) ? and species of *Corixa*. These all play a part in the destruction of mosquito larvæ.

(5) The final group to be described under this heading is that comprising the Hymenoptera (bees and wasps). These are of importance on account of their powers of stinging, and also because the former provide food in the form of honey.

Hibernating queen wasps have been found, during the winter months, in sheds and under rubbish; the first workers, in flight, were seen on June 22.

Other hymenoptera, such as Ichneumons and Chalcids, are common; they are of economic importance, since they parasitize many insects which damage crops and other foods. Some Chalcids were recently found overwintering in the adult stage, in the old nest of a blackbird, and during the summer others were seen ovipositing into the pupæ of tortoiseshell butterflies, the pupæ being attacked immediately they emerged from the larval skin and before they had time to become hard.

(B) Orders, which include species, outside the orders already specified, that damage food, habitations, etc.

(6) Coleoptera (beetles). Many species of this order are found here, both terrestrial and aquatic. The former need not be considered here, but as the latter include the *Dytiscus*, a little may be said of these.

The larvæ of *Dytiscus* are most voracious feeders, and will attack almost any other creature in the water. Two very large specimens were caught and were placed in a large vessel, which also contained a young newt; this they attacked and nearly bit in half; they also killed some small fish. Smaller specimens have been watched feeding, they remain perfectly still on the bottom of the jar, until some small creature, as a mosquito larva or *Daphnia*, comes near them, and then make a sudden dart at it, seizing it in their jaws and so killing it.

(7) Lepidoptera (butterflies and moths). There is no doubt that a very good collection of these could be made here, but being of little medical importance, they have been left more or less alone. They are however, of the greatest economic importance, owing to the damage the larvæ do to crops and vegetables.

A few of the more scarce varieties were caught for my own collection, including the goat moth (found on a telegraph pole), lesser elephant hawk moth (found walking across a road), clouded yellow and the holly blue, caught on the dyke-land.

The only species found here that might be considered of medical note, is the tiger moth; the larva of this species, if handled, may leave some of its hairs on the hand, these giving rise to much irritation. These larvæ, as their common name of "Woolly Bears" implies, are very hairy.

(8) Orthoptera (cockroaches), (9) Isoptera (white ants), (10) Corrodentia (book lice), (11) Thysanuria (fish insects), the remaining orders of this group, either do not occur in England, or have not been studied here.

(C) Orders which include species, outside the orders already mentioned, that may interest the medical officer in some more or less indirect way (e.g., preying upon flies and their larvæ; resemblance to biting insects, etc.): (12) Plecoptera (stone flies), (13) Ephemera (May flies), (14) Mallophaga (bird lice), (15) Odonata (dragon flies), (16) Neuroptera (ant lions, etc.), (17) Mecoptera (scorpion flies), (18) Trichoptera (caddis flies).

Of the above, dragon flies have been observed to destroy the adult mosquito. On one occasion a dragon fly emerged from its pupa, in an outside breeding pool; previous to this there had been many adult mosquitoes in the net over the pool, but these were rapidly destroyed by the dragon fly. Dragon fly larvæ are also known to destroy the larvæ of mosquitoes.

(D) The remaining orders do not concern the medical officer: (19) Collembola (spring tails), (20) Embidæ, (21) Thysanoptera, (22) Strepsiptera.

The above arrangement of the orders, from a medical officer's point of view, is the best that can be arrived at, in any case there must be a certain amount of overlapping.

Clinical and other Notes.

A NOTE ON THE PHYSICAL ESTIMATE OF MALARIA DISABILITY.

BY MAJOR ANGUS MACDONALD, O.B.E.

Royal Army Medical Corps.

APART from fatality it is universally recognized that the debilitating effect of malaria is a matter of extreme gravity from the point of view of the individual, and especially of employers of labour. As an employer of labour under momentous conditions the War Office, during the War of 1914-19, was greatly handicapped by the loss of strength in the armies owing to malaria infection with its attendant debility, and incapacitating sequelæ, real and presumed.

The loss of strength in the armies, due to real incapacity from malaria, has been serious enough; but perhaps even greater loss of strength has resulted from the failure, widespread, of medical officers to differentiate between the real and the presumed in their estimation of the physical condition of malaria cases. This failure has been common to youth and age, to the untrumpeted and to those of reputation. It has been due to inexperience, awe of the *ignotum ergo terribile*, and to generosity whereby the patient received the benefit of the physician's doubt. There was added, besides, the point of view of the general practitioner which, in private practice, wisely errs, on the safe side, and widely, in the terms of the advice given to the patients.

TABLE I.
MALARIA RECORD.

(1) Temperature	..	..	Nil
(2) Sclerotic and skin	..	..	Pale Ashy Melanotic
(3) Spleen	..	..	Nil + 1 increased + 2 fairly large + 3 very large
(4) Heart and lungs	..	..	Nil
(5) Liver	..	..	Nil + 1 increased + 2 fairly large + 3 very large
(6) Hæmoglobin	..	..	Fit
(7) Blood smear	..	..	Unfit
(8) General condition (Opinion)	..	..	Unfit

This combination of factors has been inimical to Army interests, to the service of the country at a time of crisis, and as well to the men themselves, and resulted in the holding up in institutions, in command depots, and on light duty in their units of men long fit for duty.

Tables are here presented dealing with the special examination of 172 men, all authenticated malaria cases, returned from various seats of war, and at the

TABLE II.—ROLL OF MALARIA SUBJECTS EXAMINED AT A COMMAND DEPOT ON OCTOBER 23, 1917.

With Result of Examination of Blood for Parasites and Relative Leucocyte Count and Recommendation of Inspector, as to Condition and Disposal, in each Case.

No.	Age	Service	Whence invalided	Cause of invaliding	Date of invaliding	When transferred to Command Depot	Report of condition at October 23, 1917.						Fit or unfit	Recommendation
							Hæmoglobin %	Parasite	Polymorphs	Lymphocytes	Large mono-nuclears	Rosinophiles		
1	30	27/12	Salonica ..	Malaria ..	25.12.16	8.8.17	75	None found	40	55	5	—	Fit	For Unit
2	47	1 10/12	"	"	25.3.17	21.8.17	80	None	53	44	—	3	"	"
3	27	2 3/12	E. Africa ..	"	26.2.17	30.8.17	75	"	61	38	—	1	"	"
4	48	1 11/12	France ..	"	5.6.17	3.9.17	90	"	59	39	1	1	"	"
5	42	2 8/12	Salonica ..	"	22.10.16	3.9.17	90	"	48	47	2	3	"	"
6	35	2 4/12	"	"	12.11.16	6.9.17	90	"	56	40	2	2	"	"
7	44	2 6/12	"	"	28.2.17	6.9.17	90	"	36	62	2	—	"	"
8	44	2 11/12	"	"	3.8.16	6.9.17	85	"	57	40	3	—	"	"
9	40	2	E. Africa ..	"	22.5.17	7.9.17	90	"	52	44	3	1	"	"
10	44	2 11/12	"	"	19.5.17	8.9.17	90	"	57	41	—	2	"	"
11	27	3	"	"	18.3.17	12.9.17	90	No	64	23	11	2	"	"
12	51	1 11/12	Salonica ..	"	8.8.16	12.9.17	85	"	57	39	4	—	Unfit	For Command Depot
13	33	2 10/12	"	"	15.7.16	12.9.17	75	"	40	51	6	3	Fit	For Unit
14	29	2 9/12	"	"	11.10.16	13.9.17	85	"	48	47	4	1	"	"
15	23	3	"	"	18.10.16	13.9.17	90	"	63	32	4	1	"	"
16	48	2	"	"	6.17	15.9.17	80	"	48	48	3	1	"	"
17	19	2 6/12	"	"	10.11.16	16.9.17	80	"	51	48	3	8	"	"
18	23	3 1/12	E. Africa ..	"	23.12.16	20.9.17	75	"	39	55	4	2	"	"
19	86	3	"	"	5.16	27.9.17	80	"	56	98	3	3	"	"
20	21	3	"	"	8.16	28.9.17	85	"	52	42	6	—	"	"
21	42	3	Salonica ..	"	8.11.16	28.9.17	85	"	34	64	2	—	"	"
22	89	2 8/12	"	"	6.3.17	28.9.17	85	"	64	34	2	—	"	"
23	21	4	"	"	2.17	28.9.17	85	"	58	87	5	—	"	"
24	50	2 4/12	"	"	5.2.17	16.9.17	80	"	52	48	—	—	"	"
25	48	2 6/12	"	"	21.6.17	27.9.17	90	"	72	24	4	—	"	"
26	29	3 6/12	"	"	26.8.17	25.9.17	85	"	44	50	6	—	"	"
27	32	2 8/12	"	"	18.1.17	25.9.17	80	"	33	59	7	1	"	"

No	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5	0	Fit	Unit	For Command Depot	For Unit
57	46	41	36	31	26	21	16	11	6	1	0	0	0	0	0	0	0	1	1	For Command Depot	For Unit
58	47	42	37	32	27	22	17	12	7	2	0	0	0	0	0	0	0	1	1	For Command Depot	For Unit
59	48	43	38	33	28	23	18	13	8	3	0	0	0	0	0	0	0	1	1	For Command Depot	For Unit
60	49	44	39	34	29	24	19	14	9	4	0	0	0	0	0	0	0	1	1	For Command Depot	For Unit
61	50	45	40	35	30	25	20	15	10	5	0	0	0	0	0	0	0	1	1	For Command Depot	For Unit
62	51	46	41	36	31	26	21	16	11	6	0	0	0	0	0	0	0	1	1	For Command Depot	For Unit
63	52	47	42	37	32	27	22	17	12	7	0	0	0	0	0	0	0	1	1	For Command Depot	For Unit
64	53	48	43	38	33	28	23	18	13	8	0	0	0	0	0	0	0	1	1	For Command Depot	For Unit
65	54	49	44	39	34	29	24	19	14	9	0	0	0	0	0	0	0	1	1	For Command Depot	For Unit
66	55	50	45	40	35	30	25	20	15	10	0	0	0	0	0	0	0	1	1	For Command Depot	For Unit
67	56	51	46	41	36	31	26	21	16	11	0	0	0	0	0	0	0	1	1	For Command Depot	For Unit
68	57	52	47	42	37	32	27	22	17	12	0	0	0	0	0	0	0	1	1	For Command Depot	For Unit
69	58	53	48	43	38	33	28	23	18	13	0	0	0	0	0	0	0	1	1	For Command Depot	For Unit
70	59	54	49	44	39	34	29	24	19	14	0	0	0	0	0	0	0	1	1	For Command Depot	For Unit

TABLE II.—Continued.

No.	Age	Service	Whence invalided	Cause of invaliding	Date of invaliding	When transferred to Command Depot	Report of condition at October 28, 1917						Fit or unfit	Recommendation
							Hemoglobin %	Parasite	Polymorphs	Lymphocytes	Large mono- nuclears	Koslinophiles		
71	22	1 9/12	E. Africa..	Malaria	15.2.17	26.9.17	80	No	57	39	2	2	Fit	For Unit
72	24	1 9/12	"	"	23.2.17	26.9.17	80	"	39	45	5	11	"	"
73	30	3 1/2	France	"	27.7.17	27.9.17	80	"	40	55	3	2	"	"
74	38	1 4/12	E. Africa..	"	2.3.17	15.10.17	90	No	62	34	4	—	"	"
75	28	1 4/12	"	"	28.2.17	28.9.17	90	"	46	50	4	—	"	"
76	26	2 11/12	"	"	4.11.16	17.9.17	85	"	54	42	4	—	"	"
77	29	1 6/12	"	"	28.5.17	18.9.17	85	"	50	47	3	—	"	"
78	31	2 4/12	France	"	20.6.17	24.9.17	85	"	55	43	2	—	"	"
79	34	1 9/12	E. Africa..	"	23.12.16	24.9.17	85	"	53	42	4	1	"	"
80	31	2 4/12	"	"	13.5.17	24.9.17	90	"	61	38	2	—	"	"
81	29	2 6/12	"	"	29.5.17	24.9.17	85	P. vivax	59	38	3	—	"	"
82	"	"	Salonica	"	20.12.17	25.9.17	80	No	42	55	3	—	"	"
83	21	1 1/12	E. Africa..	"	14.3.17	25.9.17	85	"	60	38	2	—	"	"
84	36	1	Salonica	"	20.9.17	25.9.17	80	"	36	62	1	1	"	"
85	28	1 5/12	E. Africa..	"	16.6.17	27.9.17	80	"	21	77	1	1	"	"
86	39	2	"	"	12.4.17	27.9.17	85	"	57	42	1	—	"	"
87	27	2	"	"	1.5.17	2.10.17	85	"	41	55	2	—	"	"
88	21	1 6/12	"	"	10.9.16	2.10.17	75	P. vivax	58	34	6	2	Unfit	For Command Depot
89	21	1 10/12	"	"	2.1.17	2.10.17	85	No	60	38	2	—	Fit	For Unit
90	36	2 5/12	"	"	11.10.16	2.10.17	85	"	59	33	4	4	Unfit	For Command Depot
91	22	2	France	"	12.4.17	6.10.17	85	P. vivax	55	35	8	2	Unfit	For Unit
92	23	1 1/12	E. Africa..	"	26.8.17	6.10.17	90	"	60	39	1	1	Unfit	For Command Depot
93	27	1 9/12	Salonica	"	3.5.17	5.10.17	75	No	38	40	7	15	Unfit	For Unit
94	27	1 11/12	E. Africa..	"	13.8.16	6.10.17	80	"	59	39	1	1	Fit	For Unit
95	21	1 11/12	Salonica	"	25.5.17	11.10.17	85	"	61	38	1	—	"	"
96	40	2 9/12	Salonica	"	29.9.16	9.10.17	70	Record lost						For Command Depot
97	21	2 2/12	E. Africa..	"	8.3.17	9.10.17	85	Record lost						For Unit
98	28	3 1/12	"	"	8.6.17	11.10.17	65	Record lost						For Command Depot
99	45	2 6/12	France	"	27.7.17	9.10.17	75	No	69	39	2	—	"	For Unit
100	37	1 1/12	"	"	18.6.17	11.10.17	75	Record lost						For Command Depot

[illegible]

TABLE II.—Continued.

Report of condition at October 23, 1917																		
No.	Age	Service	Whence invalided	Cause of invaliding	Date of invaliding	When transferred to Command Depot	Hæmoglobin %	Polymorphs					Lymphocytes	Large mono- nuclears	Kosinophiles	Fit or unfit	Recommendation	
								No	47	48	3	2						Fit	For Unit
145	22	2 8/12	Salonica ..	Malaria ..	10.4.17	20.6.17	85	}	63	36	1	—	—	—	—	Fit	For Unit	
146	43	2 10/12	" ..	" ..	14.3.17	2.10.17	85		65	34	1	—	—	—	—	—	"	"
147	32	3 yrs.	France ..	Malaria and trench fever	19.7.17	25.9.17	85		Record lost					—	—	—	"	"
148	23	3 2/12	Salonica ..	Malaria ..	4.17	17.10.17	90	}	63	36	1	—	—	—	—	—	For Unit	
149	25	2 2/12	Verecap ..	" ..	11.9.16	16.10.17	85		65	33	2	—	—	—	—	—	"	"
150	32	2 3/12	Macedonia ..	V.D.H. and malaria	2.6.17	15.10.17	85		63	35	2	—	—	—	—	—	"	"
151	21	2 1/12	" ..	D.A.H. and malaria	14.10.16	13.10.17	90	}	61	38	1	—	—	—	—	—	For Unit	
152	43	1 9/12	" ..	Trench fever and malaria	14.5.17	22.9.17	85		56	40	4	—	—	—	—	—	"	"
153	21	2 2/12	Macedonia ..	Malaria ..	1.17	8.10.17	90		55	42	3	—	—	—	—	—	"	"
154	22	2 8/12	Salonica ..	" ..	1.9.16	8.10.17	85	}	59	40	—	1	—	—	—	—	For Unit	
155	32	13 4/12	E. Africa..	" ..	4.5.17	6.9.17	80		72	34	4	—	—	—	—	—	"	"
156	29	2 11/12	Salonica ..	" ..	28.7.16	9.8.17	85		56	41	1	2	—	—	—	—	"	"
157	23	1 10/12	" ..	" ..	20.9.16	23.8.17	80	}	65	30	5	—	—	—	—	—	For Unit	
158	22	2 4/12	" ..	" ..	26.7.16	28.8.17	85		58	38	2	2	—	—	—	—	"	"
159	21	3 6/12	" ..	" ..	8.8.16	1.9.11	85		41	58	1	—	—	—	—	—	"	"
160	31	3	" ..	" ..	9.16	5.9.17	85	}	53	45	2	—	—	—	—	Fit	For Unit	
161	23	3	" ..	" ..	8.16	30.9.17	90		42	52	2	—	—	—	—	—	"	"
162	21	2 3/12	" ..	" ..	29.12.16	6.10.17	90		36	57	5	2	—	—	—	—	Unfit	For Command Depot
163	26	3 1/12	E. Africa..	" ..	16.5.17	7.10.17	80	}	59	39	1	1	—	—	—	Fit	For Unit	
164	21	3	France ..	" ..	3.8.17	7.10.17	85		56	42	2	—	—	—	—	—	"	"
165	22	2	Salonica ..	" ..	23.11.16	7.10.17	75		50	42	6	2	—	—	—	—	"	"
166	47	2 11/12	" ..	" ..	17.2.17	28.9.17	85	}	50	42	6	2	—	—	—	—	For Unit	
167	24	3 2/12	" ..	D.A.H. and malaria	6.16	9.10.17	80		50	43	6	1	—	—	—	—	"	"
168	32	3	" ..	Malaria ..	22.9.16	9.10.17	85		36	56	3	5	—	—	—	—	"	"
169	26	2 7/12	" ..	" ..	..	2.10.17	85	}	50	42	6	2	—	—	—	—	For Unit	
170	21	2 7/12	" ..	" ..	..	1.10.17	85		50	43	6	1	—	—	—	—	"	"
171	24	2 10/12	" ..	" ..	16.3.17	9.10.17	90		Record lost					—	—	—	"	"

(Sgd.) ANGUS MACDONALD,
Capt., R.A.M.C., S.S.O., B.D.

time under treatment at a command depot. It was under question when the special examination was called for whether these men were fit for a command depot or should be returned to hospital. From the dates given it may be seen that all had already been invalided for months and about 30 per cent. for over a year, being under quinine treatment more or less continuously over these periods.

Table I gives the scheme of examination in which certain physical data are taken which allow of accurate estimation, and from these opinion of condition at the time may justifiably be estimated. Apart from temperature and the indications of microscopical blood examination, stress is laid on the spleen and hæmoglobin records. Enlargement of the spleen (*quâ malaria*) indicates chronic extensive infection. Ten spleens were found enlarged so as to be just palpable (+ 1), and one spleen was appreciably enlarged without doubt (+ 2). But no spleen was found enlarged to such a degree as to make it a definite abdominal tumour (+ 3).

In twenty-three men the hæmoglobin index (Tallqvist) was 75 per cent or under. In general, 80 per cent hæmoglobin (Tallqvist estimation) is found consistent with health; 70 per cent is associated with anæmia; 75 per cent may be taken as a borderland of instability.

Malaria parasites were found in three cases. The men were under quinine treatment at date of examination.

Captain Geoghegan, R.A.M.C., assisted me in making a painstaking examination of each man.

Table II records regimental data (omitted), the blood examination, the final decision as to fitness, and the recommendation as to disposal. No analysis is made of the blood count record. The factors affecting a comparative leucocyte count are many, and while there are broad indications in the count, there is no sufficient pertinence to the question of fitness.

Study of the records of physical data may satisfy the reader of the justification for the estimate made and the recommendations given—seventeen men fit for Command Depot, 155 fit to return to their units.

It is contended that there are physical data readily to be obtained sufficient to establish in the case of the soldier his fitness for duty, and in the case of the civilian his fitness for work, apart from the academic question whether he may not still harbour a few stray malaria parasites in his system.

Discontinuous debility ascribed to malaria will require special judgment as it may occur.

October, 1917.

August, 1921.

The added experience of four more years of observation of war-got malaria in England yields nothing to alter and all to emphasize. The points chiefly calling for emphasis are the inveteracy with which malaria has continued to be regarded as a disability regardless of the absence of actual disablement and often independent of specific evidence of infection; the prevalence of the acceptance of paleness as synonymous with anæmia; and the infrequency of recourse to the hæmoglobin estimation as a valuable criterion of health. There has been a varying estimation of the indication value of relative leucocyte counts, and of the significance of the proportion of "large mononuclears," which will continue so long as the data of hæmatology are open to individual (mis)interpretation.

A. M.

REPORT ON AN OUTBREAK OF FOOD POISONING AT LARKHILL.

BY LIEUTENANT-COLONEL J. S. DUDDING.

Royal Army Medical Corps.

THE above outbreak occurred in the 85th Brigade, Royal Field Artillery (T.A.) on August 27 and 28, 1921; it was fortunately unattended by any serious medical complications, but is of interest owing to the nature and quantity of the chemical substance causing it.

On August 27, No. 723362 Drvr. M., "was detained by me one night suffering from mild ptomaine poisoning. He had severe abdominal pains with feelings of sickness, but was better the next day. I also heard there were seven or eight others who felt ill but who did not report sick." Signed, Medical Officer in Charge, Troops. These men had eaten sausages obtained from the N.A.A.F.I. at 16 Camp, Larkhill. The manageress stated that the sausages were obtained on the 26th inst. direct from a certain butcher "X," and about three pounds were cooked and consumed the same evening, the remainder being withdrawn as the purchasers complained of them tasting bad; they had a herby taste. Uncooked sausages (samples of these) were submitted for analysis to the Royal Army Medical College and were found to contain "borax preservative to the extent of 8.4 per cent expressed as boric acid."

On the morning of August 28, a second outbreak occurred in the serjeants' mess. The Medical Officer in Charge 14 Camp, Larkhill, reported; "I was sent for in error to the 85th Brigade Royal Field Artillery (T.A.), a unit of which I was not in charge on the morning of Sunday, August 28, 1921. As I was informed there were many cases of food poisoning I went at once only to learn that the whole serjeants' mess had been taken ill after eating sausages. The symptoms described were the same in all cases, pain (severe), vomiting and purging. By the time I saw some of the victims all were practically recovered and no treatment was needed. Samples of the sausages were sent at once by me to the Laboratory, Tidworth."

No sick report or nominal roll was obtained, but every member of the serjeants' mess 85th Brigade, suffered except the one who did not eat sausages. "The sausages were supplied by butcher 'X,' and the analytical and bacteriological report is as follows:—

(1) The rapidity of onset of symptoms one hour after consumption of the sausages, suggests the probability of chemical or toxin *intoxication* rather than *infection* with food poisoning bacilli.

(2) Bacteriological examination of the sausage contents failed to reveal the presence of any organism concerned in food poisoning. The microbic content of the sausages was very low, the few organisms present were harmless saphrophytes.

(3) Chemical examination resulted in the determination that the sausages contained borax to the extent of 722 and 815 grains per pound; the two samples for analysis were taken from different parts. This is equivalent to 469 grains and 525 grains of boric acid per pound; i.e., 7 per cent, the suggested limit of this preservative being $\frac{1}{2}$ per cent (vide MacFadden report to Local Government Board, 1908).

The symptoms were, therefore, probably due to the effects of this excess of boric acid" (signed) H. Marrian Perry, Lieutenant-Colonel, R.A.M.C., Professor of Pathology, Royal Army Medical College.

The following particulars of the attack in the case of four of the thirty warrant officers, and non-commissioned officers, affected in the serjeants' mess are given (in each case the sausages were eaten).

Serjt.-Major S. had breakfast at 8 a.m.; about a quarter of an hour afterwards felt dizzy and had to sit down. This was followed by retching and vomiting half an hour after breakfast, there being seven or eight evacuations of the stomach. He felt sick and ill for the rest of the morning, his head and face felt hot and he noticed some puffiness under the eyes, but by 4 p.m. he was more or less all right again. He had no other symptoms, there being no pain or cramp.

Serjt.-Major G. had breakfast about 8 a.m.—noted the sausages tasted saltish and highly seasoned, but not of bad food. About 8.30 a.m. he felt giddy and shortly after had severe vomiting which continued at intervals till 11.45 a.m. He had to lie down; had severe pains in the stomach, followed later by pains and cramp in the body, limbs and back: these continued for four days. He noticed his eyes became bloodshot, he felt hot and sweated at night. There was no diarrhoea, his tongue was dirty and his mouth had a nasty taste in it. His urine was thick on the next morning. He had no headache. He carried out his duties on the following day.

Serjt. T. had breakfast about 8.15 a.m.—noticed the sausages were highly seasoned, but did not look on them with suspicion at the time of eating. About 9.30 a.m. to 10 a.m. he had eructations and felt sick, he had no headache and did not vomit; condition remained same till tea-time when he began to feel better. He was all right on the following day.

Serjt.-Major N. had breakfast at 8.15 a.m., felt sick half an hour later and vomited in another half hour. The vomiting lasted for about a quarter of an hour and was accompanied by dizziness. He did not lie down. By 10 a.m. he felt better again, there were no other symptoms.

In none of the above cases was there any purging.

Inquiries showed that other canteens in Larkhill, Bulford and Tidworth, had received sausages from the same source and that complaints had been received in some cases as regards them. At Lucknow barracks canteen, the sausages supplied on August 26 had been withdrawn, as the men complained of their tasting of "soda," and left them unfinished on their plates.

At Larkhill, No. 18 Camp, canteen, sixteen partook of sausages on August 27, but only one complained to the manager. A sample of these was submitted for analysis and contained 8.7 per cent of boric acid.

At Bulford: (1) Sample "B" of sausages issued by the Royal Army Ordnance Corps canteen, on August 27 contained 9.05 per cent boric acid. (2) Sample "A" issued on August 29, at ambulance lines canteen showed 9.5 per cent boric acid, the interior portion without the skin contained 5.7 per cent of boric acid. (3) Sample "C" issued on August 29, to the Royal Army Service Corps motor transport lines canteen, contained only 0.2 per cent boric acid.

This last named was evidently from another batch manufactured at a later date than those which had caused the symptoms. The butcher went round trying to collect any unused sausages from customers whom he had supplied on

August 26 and 27, immediately he had reports of there being anything wrong, but these were not all given up to him.

On August 27 and 29, the butcher's shop was inspected and instructions were issued to prevent him from bringing further supplies and on receipt of the analysts' report his pass was withdrawn entirely.

The matter was reported to the Civil Medical Officer of Health, who took certain samples of articles used in the butcher's premises, including a biscuit meal used instead of bread in the manufacture of sausages. The butcher later informed me that he used no preservatives in the manufacture of sausages, but that he used a white powder called "articanus" for wiping down the meat. This information was passed on to the Medical Officer of Health who I understand is taking a sample for analysis; it is likely that this may prove the *fons et origo mali*.

The analyses were carried out at the Royal Army Medical College under the direction of Colonel P. S. Lelean, Professor of Hygiene.

The presence of seven per cent of boric acid means 490 grains per pound of sausages. About eight of these sausages go to the pound and as two were eaten by each member of the serjeants' mess, it is calculated that the equivalent amount of boric acid taken was about 120 grains; whilst two sausages of sample "A" would contain 166 grains.

The bacteriological report of samples "A B C" and "D" is as follows: "In none of these samples examined was a pathogenic organism isolated. All the samples contained a moderate bacterial content; the organisms isolated were (1) *Bacillus coli*, (2) varieties of staphylococci."

THE LOUISE MARGARET HOSPITAL.

BY MAJOR E. L. MOSS, C.M.G., M.C.

Royal Army Medical Corps.

There must, by this time, be a number of officers of the Royal Army Medical Corps who have been associated with this hospital in one way or another, since its foundation.

Besides these, there may be others, who might probably desire information on the present day work, services and responsibilities of this military institution.

During the late war, the medical and surgical work of the hospital was carried on continuously and to full extent, but it was not so with the work on the maternity side which slackened considerably; this was attributable to a diminished birth-rate during a time when the nation's manhood was overseas.

Dr. Watts Eden, Senior Obstetrician to Charing Cross Hospital was appointed officer-in-charge during the war.

Since the Armistice, however, the "Louise Margaret" has gradually but surely returned to its pre-war activities in this respect.

In addition to the work hitherto undertaken, the hospital has now included in its responsibilities, the organization and administration of the child welfare work of the Command.

Five "Welfare Centres" have been opened, and are at present in full work.

Two are situated in the south camp, one in north camp and one each at Bordon and Blackdown.

The women and children's medical inspection rooms exist and function as heretofore, but their work is specially arranged to co-ordinate with that of the Child Welfare Centres. Both are conducted under the same roof. The medical inspection rooms are open daily for sick at 10 a.m., and the welfare centres once a week, at 2.30 p.m.

The medical officer in charge of the women and children in each area, combines and co-ordinates the work of both "sick" and "welfare" sides, and is responsible for its efficiency to the officer in charge of the Louise Margaret Hospital. An exception is made in this respect, as regards the medical officers in charge of women and children of the Bordon and Blackdown districts; these are responsible to the senior medical officers of their respective districts.

A qualified nurse of the S.S.F.A., attends each medical officer on all occasions at both "sick" and "welfare" inspections. She also visits the sick in their quarters, attends to the hygiene of the home, and "follows up" welfare cases requiring supervision and treatment as directed by medical opinion.

Each district has a Senior Lady (a General's wife in Aldershot and a Colonel-Commandant's wife in the districts) directing the social side of the welfare movement. This lady attends her particular "centre" weekly, and has ladies of the Division, or Area, working under her guidance. Tea is served gratis to all patients on these occasions, and garments, made by the ladies themselves or at their instigation, are sold at cost price for the benefit of the infants of the poorest mothers.

The cutting out of garments is also taught, and libraries have been opened from which books can be obtained by the mothers.

The medical officers in charge of the welfare centres see all expectant mothers, and also, all those recently confined whether they have been previously in the Louise Margaret or not. All expectant mothers are examined by the officer-in-charge of the Louise Margaret before admission to hospital, and any treatment considered necessary for the mother, is carried out at the centres.

As regards the newly born infants full particulars of weight, condition, etc., are recorded on special forms and fresh entries are made weekly on these and other matters considered necessary to record. Besides the attention given to the newly-born infants, all other children found by the medical officers at their monthly inspection of the schools, to have defects in nutrition, eyesight, hearing, etc., are seen at the "centres" and transferred for examination and treatment to specialists in these departments working at the Connaught and Cambridge Hospitals. Dental clinics are established at each centre. Arrangements are made by the ladies conducting the social side of the welfare, in collaboration with the medical officers concerned, to send women and children requiring rest, change of air and any special treatment to institutions or homes situated in the country or seaside, known to be capable of dealing with such cases.

The Aldershot (Military) Branch of the Soldiers' and Sailors' Families Association help in supplying clothes and money to enable patients to go to these homes in comfort.

Some idea of the amount of work performed by officers in charge of women and children (in addition to the work already outlined, the hospital work, and

school inspections) may be gathered from the fact that during the past twelve months no less than 6,500 visits were paid to patients in their own quarters or private houses, and over 9,500 patients were seen at the three medical inspection rooms.

Cases requiring admission to hospital from the out-patient departments of the medical inspection rooms and welfare centres are sent to the Louise Margaret, to which medical officers in charge of women and children in Aldershot are attached, and thereby enabled to follow up their cases.

Some additions to the existing hospital buildings have lately been completed. Each maternity ward has now its own annexe, bath room, etc., thus completing a long-felt requirement.

The operating theatre has, to a large extent, been re-equipped with surgical instruments and aseptic furniture. It has now also the advantage of being heated by electric radiators, capable of warming it in a few minutes to any required temperature. The theatre has been in daily, and often in nightly use. This is shown by the fact that during the past twelve months over 500 operations were performed in it. Of these, half were small undertakings, but the remainder include many interesting major surgical and obstetrical operations, including hysterectomies, Cæsarean sections, ovariectomies, salpingectomies, and appendicectomies.

Children suffering from enlarged tonsils requiring enucleation are admitted and kept in hospital two or three days.

The present-day organization for the treatment of women and children therefore affords ample opportunities for medical officers to obtain clinical knowledge at first hand, and also enables them to undertake operative work and engage in practical obstetrics at the Louise Margaret, an arrangement which promotes continued observation and treatment of cases which must benefit both patients and medical officers.

On the maternity side of the hospital there were, during 1920, 497 confinements with no maternal deaths. These numbers include 476 vertex, 17 breach, 1 face, and 3 transverse presentations. There were, in addition, 3 cases of eclampsia, 3 of placenta prævia, 9 of twins, and 1 of triplets. Two successful Cæsarean sections were performed for centrally situated placenta prævia.

In connexion with the maternity work there have been at least three interesting cases requiring abdominal section. They all came to hand when pregnancy was far advanced.

Two of these were cases of acute appendicitis, one of which was straightforward and uncomplicated; but the other had developed a large abscess encircling the right and posterior surfaces of the uterus. The third was a case of ovarian cyst, the size of a football, with a twisted pedicle.

All these cases were operated on in the ninth month of pregnancy. Forceps were employed in the second stage, in each case, to avoid unnecessary abdominal strain on the recent operation wound. The operation wounds continued firm and sound, therefore no secondary operation on them was required. The infants, to all appearances, were healthy and of full-term maturity.

The following cases of double uterus are of interest. They were admitted to hospital within a fortnight of each other. Mrs. H. had the following history: At the time of the still-birth of her first child, nine months prior to admission, there was noticed an escape of offensive gas immediately following the expulsion of the

placenta. At the same time, on the right side of the uterus, a swelling was recognized. This was thought to be possibly a fibroid. It was, however, considered desirable to carry out a "Wassermann's" reaction, but this proved negative, and in addition no *Treponema pallida* were discovered in the foetal tissues. The patient had quite a normal puerperium. Nine months later she was readmitted to hospital for severe dysmenorrhœa, especially noticeable immediately after the "periods." On examination a mass was recognized situated on the right side of the uterus, about the size of an orange.

An exploratory operation revealed this to be the smaller half of a uterus-bicornis which was found to contain dark menstrual fluid, and from which *Bacillus coli* was isolated.

Free fluid of similar character was found in the lower abdomen, and numerous adhesions existed between the uterus and intestines. The rudimentary right half of the uterus, with its diminutive ovary and tube, was removed. The left uterus, with its ovary and tube, was found normal except for adhesions. The patient made an uninterrupted recovery, and has been free from pain since the operation.

The second case, Mrs. G., had a complete uterus didelphys with two separate os externa. Her menstrual periods were so very excessive that her general health suffered; because of this, and also in view of possible complications in the event of pregnancy taking place, hysterectomy was performed. No previous treatment had given any relief to the menorrhagia from which she suffered.

One other case that could not be diagnosed without an exploratory operation was that of Mrs. P., who gave the following history: Ten days before admission she had, whilst washing clothes, fallen over a bucket. She felt acute pain in her side after it, but carried on her work as usual, and did not go to bed. At a dance a week later she felt faint, and, on arrival home, sent for a doctor. On admission to hospital her pulse was 110 and temperature 99° F. Her pulse remained consistently over 100. There were no definite abnormal signs found on examination, except some tenderness in the left lumbar region. The general indications of some internal injury having taken place were, however, considered sufficient to justify an exploration of the abdomen. Laparotomy revealed a rent 2½ inches long at the lower end of the spleen and on its outer surface. The rent was not bleeding and was filled by a blood-clot, which was left undisturbed. It is doubtful if this clot would have remained where it was had the upright position been maintained. Blood and clots were found on the left side of the abdomen; these were sponged out and a drainage tube left in for forty-eight hours. The patient recovered without any further hæmorrhage.

The nursing staff of the hospital consists of a matron, nine sisters, and staff nurses Q.A.M.F.N.S., and ten pupils. The pupils are civil nurses who, having completed their full training in medical and surgical work at a recognized hospital, wish to obtain the certificate of the Central Midwives Board. The "Louise Margaret" is one of the recognized centres in this part of the country for theoretical and practical training in this subject.

It is noticeable that there is an ever increasing demand from officers (especially junior officers) for their wives to be admitted to hospital for operation or confinement. In these democratic days many of our officers have risen from the ranks, and both they and their wives feel the withdrawal of a privilege previously obtained. Few of them can afford to pay eight to ten guineas a week for nursing

homes. With the present accommodation in our families hospitals, this is, of course, out of the question—extra cubicles and wards, and extra nursing staff would be required. The lot of the young officer's wife who is "hard up" is a very pathetic one when she is taken ill in lodgings; the rooms generally occupied are, as a rule, totally unsuited for either sick nursing or the important operation of an aseptic accouchement. What infinite pains and elaborate arrangements are undertaken to save the life of an adult male destined, perhaps, to be never physically perfect again, and yet, on the other hand, what little thought is often given to the prevention of prenatal and maternal risks by the neglect of provisions that will enable modern principles in midwifery to be carried out.

In conclusion, one is often questioned about "Twilight Sleep," or painless midwifery. The exhibition of hyoscine and morphia in selected cases of parturition is recognized to be both useful and beneficial, provided it is known that the injections employed must cease to be administered at a given time, and that none should be employed within two hours of the birth of the child. If these precautions are not taken, cases of asphyxia will occur. Let it be remembered that once a patient is started on hyoscine and morphia, either the doctor or nurse *must be* in the room all the time. It is not possible to determine what the mother may do if left by herself. A "twilight mother" has been known to become most violent and difficult to manage, though apparently conscious of her acts, and yet, when the confinement is completed, has no recollection of what she has gone through, and exhibits no symptoms of shock. The dosage is generally regulated by memory tests, but the point that must be emphasized is, that these drugs cannot be given as a hospital routine, nor can they be given to numbers of patients who are being confined at the same time, for each case necessitates that the attendant nurse may stay with the patient throughout the confinement.

Hospital staffs are not large enough to allow any but selected cases to receive this line of treatment.

I wish to thank Major-General Guise-Moores for his assistance in drafting the above notes.

Lecture.

GAS WARFARE.

BY MAJOR W. R. GALWEY, O.B.E., M.C., R.A.M.C.

LECTURE II.—EFFECTS OF POISONOUS GASES—EARLY AND LATE.

SINCE the advent of chemical warfare, a very large number of substances have been examined with a view to determining their suitability from the points of view of production in quantity, use in shells, bombs or projectors, and the physiological effects on human beings and other animals exposed to them.

A detailed list of these substances would serve no useful purpose and it will suffice to show how they may be grouped into the following classes according to their physiological effects and to mention one or two of the more important substances in each group.

- (1) Lachrymators.

- (2) Sensory irritants of the eyes, nose and upper respiratory passages.
- (3) Vesicants.
- (4) Asphyxiants or acute lung irritants.
- (5) Direct poisons of the nervous system.
- (6) Gases which act by interference with the respiratory property of the blood.

	Compound	Formula	Boiling point °C.	Characteristics
Group (1) Lac- hrymators	Benzyl bromide	$C_6H_5CH_2Br$	198	Colourless liquid with pungent smell
—	Xylyl bromide	$C_6H_4CH_2CH_2Br$	185	—
—	Brom. acetone	$CH_3BrCOCH_3$	137	Pale yellow liquid with pungent smell.

(2) Sensory irritants of the eyes, nose, and upper respiratory passages. Examples: Di-phenyl. chlor. arsine $(C_6H_5)_2AsCl$ melting point $43^\circ C.$; boiling point $333^\circ C.$; faintly odorous, yellowish oil or as a solid; ethyl-di-chlor. arsine, $C_2H_5AsCl_2$, boiling point $156^\circ C.$, faint ethereal smell.

(3) Vesicants. Examples: Di-chlor. ethyl sulphide (mustard gas) $S \begin{smallmatrix} \diagup CH_2CH_2Cl \\ \diagdown CH_2CH_2Cl \end{smallmatrix}$ boiling point, $217^\circ C.$; a pale yellowish oil, odour of garlic or mustard.

(4) Asphyxiants or acute lung irritants. Examples: Chlorine Cl_2 , boiling point $33^\circ C.$, greenish-yellow gas, smell of bleaching lime; phosgene (carbonyl-chloride) $COCl_2$, boiling point $8^\circ C.$; colourless gas, smells of musty hay, tobacco gives a characteristic taste after phosgene has been inhaled.

(5) Direct poisons of the nervous system. Example: Hydrocyanic acid HCN , boiling point $26.5^\circ C.$, melting point $13.8^\circ C.$; colourless mobile liquid with smell of bitter almonds.

(6) Gases which act by interference with the respiratory properties of the blood. Example: Carbon-monoxide; colourless, odourless gas, lighter than air.

This classification is to some extent artificial, for in certain instances the groups merge into each other, e.g., some lachrymators are asphyxiant in high concentrations and the asphyxiants cause lachrymation. Again, the arsine compounds besides being sternulators cause lesions in the lungs and possibly in the central nervous system.

ASPHYXIANTS.

Confined to the upper air passages these substances may reflexly inhibit breathing and may produce anæsthæsia of the mucous membrane with loss of taste and smell.

If they reach the larynx in quantity they may cause immediate suffocation through spasm of the glottis.

In the pulmonary air passages they may cause intense bronchial spasm, also necrosis and stripping of the mucous membrane leading to mechanical blocking of the air passages. If they reach the air cells in large quantities they may penetrate the epithelium and the capillary walls and directly affect the blood, and so lead to those changes which bring about a blocking of the pulmonary circulation.

Immediate death has occurred in laboratory animals exposed to high concentrations of phosgene. When this happens, intense venous and capillary

congestion and subdural hæmorrhages in the brain are found. The lungs show practically no œdema. The blood-vessels in the lungs are much congested and inundated with a brownish granular material. The blood in the systemic circulation is normal to spectroscopic examination. Death is thus accompanied by and probably due to an immediate pulmonary vascular stasis resulting in acute asphyxia.

Cats exposed to chlorine 1·700 died in less than fifteen minutes, the blood being almost black, arterial pressure falling rapidly and there being no asphyxial rise, and practically no lung œdema.

Pulmonary changes appear to be a necessary stage in all the pathological effects of the irritant gases. With doses of such a strength as to cause death in two hours; damage of the lung seems a necessary factor.

In smaller quantities than those giving rise to effects just described, the asphyxiants may injure in various degrees the bronchial mucous membrane and the epithelium of the air sacs and capillary walls, without actually penetrating into the capillary vessels, the lesions giving rise to intense pulmonary œdema.

Finally, a secondary bacterial infection may lead to pneumonia and infective inflammation of the respiratory passages.

The condition brought about after the injury to the capillaries and air cells is one of want of oxygen, and to this most of the serious symptoms and the sequelæ of asphyxiant gas poisoning are due. In fact, there is no good evidence that with moderate concentrations of gas, any system of the body other than the respiratory is primarily damaged. So far as the evidence goes at present, the lesions found in the other organs are a consequence of the interference with the respiratory exchange of oxygen.

Of the typical asphyxiants chlorine affects the upper air passages and bronchial tree primarily; while the action of phosgene is chiefly on the cells of the lung alveoli. Chlorpicrin is intermediate between the two.

Experimenting with dogs, Underhill found that chlorine has a very strong irritative action, an animal gassed therewith becoming excited and in evident distress. With chlorpicrin the character of the reactions is very similar but less pronounced. With phosgene, on the other hand, the animals appeared to be in no immediate distress.

To some extent this difference of reaction can be explained. When the substance is introduced in the atomized condition, if the spray is coarse it may be entirely held up in the upper respiratory passages. A fine spray, on the other hand, may reach the alveoli. If the substance is very soluble, as ammoniac, the moisture of the surfaces of the air passages would largely entrap it. Possibly also a substance may be comparatively innocuous to the more resistant epithelium of the air passages, and only effective on the more delicate lining of the alveoli. Or again, the vapour may have an affinity for some tissues while it is relatively indifferent to others, as in the case of mustard gas, which attacks the epithelium of the air passages, but not that of the alveoli.

In acute deaths from asphyxiant gas poisoning, i.e., those occurring in about twenty-four hours, the most striking changes are found in the lungs. The following are the gross lesions found in human beings.

On opening the thorax the lungs are voluminous, and hardly collapse at all. Distended lymphatics and small subpleural hæmorrhages are visible on the surface. Rarely the hæmorrhagic areas coalesce with stripping of the pleura.

Air from damaged lungs is visible as chains of bubbles below the visceral pleura along the interlobular fissures, and occasionally penetrating into the tissues of the mediastinum and into the subcutaneous tissues.

The whole external surface of the lung shows deep purple areas of collapse or consolidation slightly depressed below the surface, alternating with irregular areas of acute emphysema of a light greyish colour. Emphysematous patches are more numerous along the margins and diaphragmatic surface of the lung where bullæ are sometimes found.

In the pleural cavities are found serous fluid in varying quantities and some traces of blood.

The lungs, on removal, weigh several times their normal weight. They feel wet, and on section drip frothy fluid and blood. The irregular patches of collapse and emphysema extend throughout the lung substance. Occasionally definite infarcts are found.

The fluid collected from the lungs of animals dying with acute pulmonary œdema is clear straw-coloured, and occasionally contains a few red blood corpuscles. Underhill found that its chloride content is essentially the same as that of a simultaneous sample of blood plasma. This shows that there is complete permeability of the pulmonary capillaries for salts. The œdema fluid and blood plasma are in equilibrium as regards their salt content.

The trachea and bronchial tubes are largely filled with thin, yellowish, highly albuminous fluid, which sometimes escapes as a froth from the mouth and nostrils after death.

The degree of inflammatory change in the mucous membrane is variable. In severe cases the lining of larynx, trachea and bronchi is of a deep purple colour, swollen and œdematous. The epiglottis is affected to a less extent than the trachea and the œdema of the larynx is not sufficient to endanger life.

The mucous membrane of the pharynx is generally dry, glossy, and somewhat congested.

Sometimes only the lower trachea and bronchi are affected, and occasionally (as in cases of pure phosgene poisoning) they are normal save for frothy fluid.

It is stated that a false membrane was rarely found in cases which survived to reach a medical unit.

If death is delayed to the second or third day the aeration of the lung tissue is better; and if the patient survives till the fourth day areas of broncho-pneumonia and pleurisy may be found.

In examining lungs from animals killed at various periods after gassing one is struck by the very small amount of sound lung tissue with which the animal appears to be able to carry on.

On examination of the *circulatory system* engorgement of the large veins is found. The right heart is generally but not invariably distended, and sometimes petechial hæmorrhages are found in the endocardium. Sometimes there is an increase in the pericardial fluid. The blood clots rapidly and its concentration is above normal.

Abdominal Organs.—There may be petechial hæmorrhages and slight ulceration in the stomach. Large hæmorrhages in the stomach cavity have been described.

There is a general engorgement of viscera; enlargement and nutmeg appear-

ance of the liver and enlargement and congestion of the kidneys are found; but frequently in experimental animals no abnormal appearances are observed.

Central Nervous System.—In early deaths as a general rule only engorgement of vessels, both meningeal and cerebral, is found; but when death follows after two or three days of cyanosis and unconsciousness due to want of oxygen, tiny petechial hæmorrhages are seen surrounding vessels throughout the whole of the white matter. Similar hæmorrhages have been found in the brain in deaths which were ascribed to shell-shock, but as Sir F. Mott has pointed out such deaths may in reality have been due to poisoning by the carbon-monoxide generated by the shell explosion.

The punctiform hæmorrhages occurring in the white matter are primarily due to the anatomical conditions of the vessels in the cerebrum, where they are terminal, each small artery having a separate capillary system, as is also the case with the emerging veins. A tendency to stasis may be brought about in these separate vascular systems by the failure of the heart as a force pump, also by respiratory conditions which lead to right heart dilation and interference with return of blood from the skull. In those gas cases where the hæmoglobin has been converted into pigment the hæmorrhage may arise from occlusion of the arteries.

Observations on animals have enabled observers to give a fairly clear account of the sequence of events which lead up to the post-mortem appearances described above. Professor Shaw Dunne made extensive observations at Porton on goats gassed with phosgene, and the following account of the changes in the lungs is abstracted from his paper:—

By the end of half-an-hour after gassing on inspection of the lungs red areolæ are observable in the centres of alveoli. Fluid accumulates in the interlobular planes, which are seen as fissures, and under the pleura.

On microscopic examination alveolar œdema is found. Masses of light granular material are seen most commonly in the openings of the infundibular cavities toward the centres of the lobules. This light œdema is found all over the lungs. At this stage desquamated pulmonary epithelial cells and red-blood corpuscles can be seen in the œdema in small numbers.

The interlobular planes of connective tissue show marked œdema, the fibres forming them being widely separated by granular material representing fluid.

The lymphatic vessels in these planes are distended as are those in the bronchial and arterial walls.

In the central lobules there is blocking of the capillary vessels in the alveolar walls by minute thrombi. This phenomenon may be seen as early as half an hour after gassing, but is usually well advanced by two to three hours. In the earliest recognizable stage the damaged vessels appear collapsed and contain few red blood corpuscles but many leucocytes. The process is confined to the rows of alveoli nearest to the infundibular openings. On the fringe of this area the capillaries are much engorged with blood in contrast with those situated more peripherally. The latter are almost empty as in a section of normal lung.

The engorged state of the capillaries points to stasis of blood in them during life.

At quite an early stage the musculature of the bronchiolar termination and infundibula is affected. The fibres are swollen and tend to lose their striation.

In some cases these muscles are in a condition of spasm so that groups of alveoli are distended with air which cannot escape. This condition has been found to persist as late as twelve hours after gassing. As it affects the airways to both cedematous and non-cedematous areas it tends to prevent loss of function in the former being compensated by the latter and so increases the lack of oxygen of the animal.

At this stage the superficial layer of ciliated cells of the bronchi also show evidence of damage.

During the initial period of three to four hours the amount of fluid which remains in the air spaces is very small, though a great excess must escape from the capillaries which have undergone a less severe lesion than those which are actually thrombosed. The cedema in the interlobular planes indicates this and also shows how rapidly an abnormal exudate can be got rid of from the alveoli.

After this initial stage naked-eye examination shows extension and intensification of the cedema with progressive diminution of the normal post-mortem collapse of the lungs. The reddening in the centre of lobules extends to whole lobules and deepens in tone. The surface of the lung is mottled in varying shades of red, as some lobules are more affected than others. Later large areas become entirely filled with fluid to the exclusion of air.

By the end of forty-eight hours the condition of light profuse and universal cedema is no longer seen. In the majority of the animals observed there are greater or less tracts of solid lung, contrasting with areas in which cedema is slight or absent and aeration well established.

Histological examination shows a further development of the changes observed in the early stage. The alveolar cedema is more abundant and more generally distributed. The solid residue of the cedema is denser in consistence. It may appear as a reticulum like fibrin or a homogeneous mass like colloid. Every alveolus in a lobule and also the infundibular cavities and terminal bronchioles may be full of it. Even where there is a vacant space representing air this may be situated centrally so that it is away from the capillaries and alveolar walls. If cedema persists for more than twenty-four hours the alveolar walls may show thickening and many of their epithelial cells may be desquamated and lie in the cedema residue. There may be a few polymorphonuclear leucocytes in the exudate.

There is evidence of loss of tone in the elastic fibres in the alveolar walls.

The smaller bronchi and bronchioles show loss of superficial ciliated cells, but rarely is the whole epithelial coat destroyed.

In places bronchioles are partially blocked. Those which lead to solid lobules become filled by albuminous material, mucus and epithelial debris.

Capillary thrombosis undergoes very little extension after the initial period, and persists practically unchanged for thirty-six to forty-eight hours. It is always accompanied by much engorgement of the neighbouring capillaries. The fluid in the alveoli diminishes the lumina of the capillaries since it subjects their walls to greater pressure than would the normal content of air.

Up to forty-eight hours after gassing, then, the outstanding feature is progressive diminution of aerating surface by fluid accumulating in the alveolar spaces. As the distribution of the cedema is not uniform, a greater or less extent of lung may remain relatively free and may suffice to keep the arterial blood sufficiently aerated till the cedema subsides.

There is experimental evidence to show that though the circulation in the capillaries is much impeded by intense œdema the total blood flow is fairly well maintained, therefore a greater proportion than usual must pass through the less œdematous portions where some degree of oxygenation can be effected.

The accumulation of fluid seen in the interstitial planes and under the visceral pleura and the exudation in the pleural cavity shows how the fluid escaping from the alveolar capillaries is being continuously drained off. The amount remaining in the alveoli shows how far supply is in excess of disposal.

As a rule in animals gassed with phosgene death during the first forty-eight hours is associated with an extreme degree of pulmonary œdema, and as a result of fluid in these spaces the greater part of the respiratory area is out of action. Death is thus due to diminution of the supply of O_2 to the blood and this conclusion is confirmed by blood gas analysis.

In animals dying in first twenty-four hours the œdema though universally distributed is not so intense. Death in these cases may be due to oxygen lack combined with shock or lower resistance.

In animals dying on third day it is found that the pulmonary lesions are on the decline; the alveoli could take in air if the necessary respiratory effort were forthcoming. In such cases it is possible that the earlier lack of oxygen has brought about failure of the heart and respiratory centre.

It is usual for animals to die within the first two to three days after gassing with phosgene, deaths at a later period are frequently due to secondary infection. In animals which have survived till the third or fourth day and have then been killed for purposes of examination there is evidence of the decline of œdema. The only visible œdema is on the ventral aspects of the lungs, but the affected portions are almost entirely solid. The lesions may be scattered or occupy large areas. The main body of the lungs appears fully aerated. The aerated portions collapse less completely than normal.

The contrast between the solid areas and expanded areas is extreme. It is probably due to the œdema in the greater portion of the lungs being insufficient to interfere seriously with aeration, so that expansion and contraction is not checked. The movement of the lung tissue and compression of air will aid drainage of fluid through the lymphatics. On the other hand in solid lobules no such help is given and air may not even enter choked bronchioles.

In the worst cases amongst goats which recovered, Dunn found solid œdema in one-third to half of each lung and œdema in some degree in the remaining portions.

By the fourth day there is definite evidence of the absorption of œdema. The lungs are less bulky and there is obvious shrinkage of the solid areas. The dorsal parts of the lungs are fully aerated. The margins of the solid and aerated areas are not sharply differentiated, there is an intermediate zone where re-expansion is proceeding slowly. By the fifth day scattered lobules in the solid areas are aerated.

By the eighth day only small areas remain unexpanded.

In animals surviving to the fifth and sixth week the lung has resumed its normal appearance.

Microscopic examination shows how reparation is brought about. The more lasting the œdema in a lobule the greater is the amount of histological change

developed. The maximum alteration is in the area of thrombosed capillaries. The alveolar walls here become thickened partly owing to œdematous swelling of their connective tissue elements, partly to increase in the number of their cells. The thrombi are disposed of by phagocytic action, and the capillary network is ultimately completely reformed. The thin pulmonary epithelium is replaced by closely set cubical cells like those in the terminal bronchioles. The reparative changes are therefore of a subacute inflammatory character. The albuminous material shrinks and is attacked by phagocytes from the pulmonary epithelium. In the more peripheral portions of the lobule outside the thrombosed area there is slight thickening of the alveolar epithelium which later disappears.

The Signs and Symptoms of Asphyxiant Gas Poisoning.—All the gases which act as lung irritants cause practically the same type of symptoms, though the time of onset and the concentration necessary to cause symptoms of the same severity differ with particular gases. The picture also varies slightly according to whether the gas affects primarily the respiratory passages or the alveoli of the lung.

Exposure to an atmosphere containing one of these gases causes immediate sensory irritation accompanied by smarting and watering of the eyes. The irritation of the respiratory passages causes catching of the breath, coughing, and a sensation of tightness in the chest. The intensity and duration of these early symptoms depend upon the concentration.

Even a very mild dose of phosgene may cause a feeling of lassitude and general discomfort for some hours. As a rule nausea, vomiting and retching are prominent features in the early stages.

Inhalation of phosgene causes a very characteristic change in the taste of tobacco.

The onset of œdema of the lungs is signalled by deep cyanosis or leaden-coloured facies, the cough and frothy expectoration, the distress and restlessness, the quickened respiration and rapid pulse which are characteristic of a serious case of gas poisoning. These signs are usually well established by the time a patient is admitted to a field ambulance or casualty clearing station. In the case of phosgene poisoning, there is, however, sometimes considerable delay and a man apparently only slightly gassed may carry on his duty for several hours and then become seriously ill.

Headache, pain behind the sternum and in the epigastrium, are associated with these signs and symptoms in the majority of patients. As the case develops want of oxygen becomes more serious and dominates the clinical picture.

The serious cases may be divided into two groups:—

(1) Those which show definite signs of venous engorgement, i.e., congested and deeply cyanosed face, blue lips and tongue, visible distension of the superficial veins of the face and neck, increased breathing which is often deeper than normal. Cough may be present and accompanied by abundant thin frothy fluid. The pulse is full, of good tension and beats about 100 per minute.

(2) In the second group the deep cyanosis is replaced by an ashen pallor, the lips being pale and of the colour of lead. The patients are collapsed, respiration is rapid and shallow, the pulse is rapid, weak and running up to 130 to 140 per minute. There is often little cough or expectoration.

This latter group predominates in phosgene poisoning. Of these serious cases

in both groups, some exhibit extreme restlessness and anxiety, others a semi-coma and muttering delirium. Consciousness may be maintained to the end.

Sometimes a case in the first group will gradually assume the characteristics of the second group.

Four-fifths of the deaths occur in the first twenty-four hours and very few after the third day. This has also been observed in animals gassed for experimental purposes.

A case apparently slight during the first twenty-four hours may rapidly go downhill and die on the second day; but, generally speaking, for the less severe cases the danger is passed on the second day.

Bacterial infection may lead to the characteristic signs and symptoms of broncho-pneumonia developing on or after the fourth day and this complication may rapidly kill the patient. Deaths from this cause are not so common as might be expected.

As a rule by the end of a week a patient is convalescent. During convalescence there is often a temporary bradycardia.

Complete recovery may take a considerable time and a certain percentage of patients develop symptoms which are very troublesome and intractable to treatment. These cases fall into three main groups:—

- (1) Cardiac.
- (2) Spasmodic dyspnoëic.
- (3) Combined cardiac and dyspnoëic.

(1) Cardiac.—These patients exhibit the characteristic signs and symptoms of the effort syndrome or irritable heart, i.e., precordial pain, dyspnoëa, exhaustion and persistent tachycardia after exercise. The patient may look “done” after walking half a mile in ten minutes and may be quite incapable of going upstairs quickly.

(2) The characteristic symptom of the second group is spasmodic attacks of dyspnoëa at night. They may occur every night or at intervals of a week. During an attack the patient sits up in bed, his breathing is rapid and shallow, but not difficult, resembling the dyspnoëa of uræmia rather than that of asthma. Slight cyanosis may be present. The attack may last up to thirty minutes and several may occur during the same night. The pulse may be slow and full or rapid and thready. Such a patient on exercise suffers from intense headache and giddiness. The pulse rate after exercise may fall rapidly, unlike that of the cardiac group. In these patients the blood usually shows a hæmoglobin percentage over 100.

(3) A third group combines the symptoms of the first two.

All these groups suffer from pain in the head, pain in the abdomen, usually worse after food, and pain in the chest.

The above description gives a fairly typical picture of the course of a case of gas poisoning; there remain, however, a few observations made either clinically or by laboratory examination of gassed animals which are of importance.

(1) *Respiratory System*.—The percussion note may remain resonant all over the chest, notwithstanding the presence of marked pulmonary cedema. The breath sounds are weakened, especially behind. Fine râles and rhonchi are heard.

Considering the extreme damage to the lungs the physical signs give little indication of the seriousness of the case.

(2) *Circulatory System*.—In the early stages the pulse may be so rapid as to be uncountable. This may be due to shock or to an early developing condition of oxygen want. Another early sign in some cases is acute dilatation of the right heart. This may be only temporary, disappearing during convalescence.

The second cardiac sound is accentuated; this is connected with raised tension in the pulmonary artery.

In experimental animals blood-pressure falls early and the fall is permanent. The initial fall may be preceded by a temporary rise, and this occurs before there are distinct signs of lung oedema or an asphyxial state of the blood. This fall may be due to the development of an early want of oxygen reacting on the spinal and medullary centres, or to dilatation of the pulmonary vessels leading to stasis of blood in the lungs and its withdrawal from the systemic circulation.

(3) *Changes in the Blood*.—Concentration of the blood is a marked feature of cases of gas poisoning. This is brought about primarily by the production of pulmonary oedema, but is contributed to by shock which leads to stagnation of the blood in the capillaries, and by partial asphyxiation of muscular and other tissues which brings about increased local production of lymph.

The curve of the concentration of the blood follows closely that of the percentage of hæmoglobin as measured by a hæmoglobinometer, and Hb. values up to 140 per cent. have been obtained. This means that the concentration of red blood corpuscles is really forty per cent. greater than normal, and therefore the potential oxygen-carrying capacity is increased; but on the other hand analysis of the blood gases shows that the actual oxygen content is seriously diminished, and that the increase of corpuscles does not compensate for this loss.

It should also be noted that the increase of red blood corpuscles at this stage is relative and not absolute.

Later, a true polycythæmia may develop in certain cases which are slow in convalescence; it may be regarded as a compensation for chronic oxygen deficiency.

(4) *Digestive System*.—Acute gastritis occurs in fatal cases, and chronic dyspepsia is one of the commonest sequelæ of gas poisoning.

(5) *Excretory System*.—The kidneys are congested, as a rule, in cases which come to the post-mortem table. Albuminuria is found in poisoning with chlorpicrin.

In goats dying as the result of gassing with this substance and with phosgene, a condition of acute necrosis of the kidney was found. This change is probably due to a circulatory deficiency, and not to the direct effect of the gases themselves.

Gases which interfere with the Respiratory Functions of the Blood. Carbon Monoxide.—This gas, though not used directly for offensive purposes, was a cause of casualties, being generated when camoufflets in mines were blown, when high-explosive shells burst in a confined space, and from the discharge of machine-guns in insufficiently ventilated pill-boxes; from charcoal braziers in dug-outs and from the exhaust gases of motor engines in tanks.

Carbon monoxide combines with the hæmoglobin in the blood as does oxygen, but has about two hundred and forty times the affinity for hæmoglobin that oxygen has. When blood is exposed to an atmosphere containing CO and O₂, the hæmoglobin divides itself between the gases in proportion to their relative partial pressures.

The gas acts as a poison simply through its exclusion of oxygen from the red-blood corpuscles, so that want of oxygen develops—the degree of want of oxygen depending upon the amount of CO hæmoglobin present and upon the fact that when part of the hæmoglobin is combined with CO the dissociation of oxygen in the tissues is slower than normal.

The symptoms of the poisoning depend upon the degree of saturation of the blood with the gas, and vary from giddiness and headache to loss of consciousness, respiratory and cardiac failure and death.

The treatment is pure oxygen at once. This is given not for the purpose that oxygen is given in asphyxiant gas poisoning, but to drive the CO out of combination with the hæmoglobin, since the amount which the hæmoglobin combines with depends upon the partial pressure of CO and of O₂ in the blood. Care should be taken that the patient does not re-breathe his own expirations. As soon then as the CO has been driven out, the O₂ may be stopped—though, on account of the damage already caused by lack of oxygen, the patient may not recover consciousness at once, or, indeed, may not recover at all.

You are all, no doubt, familiar with the cherry red colour which the blood develops in the presence of CO.

The box respirator does not protect against CO poisoning and in entering mines, etc., when it is present, it is necessary to wear an oxygen-breathing apparatus.

Direct Poisons of the Nervous System.—Hydrocyanic acid is a direct tissue poison, but the nervous system is peculiarly susceptible to its action.

Concentration of the gas is of more importance than duration on exposure, i.e., it has practically no cumulative effect. When a certain concentration is attained, the action is very rapid, but if the concentration is low it may be borne for a considerable time without ill effects.

Symptoms follow each other in rapid succession—giddiness, confusion, headache, indistinct sight, palpitation, and pain in the chest and over the heart, laboured breathing, unconsciousness, convulsions, failure of respiration, and finally of the heart. In large doses death is almost immediate.

The respiratory centre is rapidly paralysed—immediate treatment, therefore, is necessary. The patient must be brought into fresh air, and if the respiration is stopped, or gasping and weak, Schäfer's method of artificial respiration must be resorted to immediately. This is the essential in treatment, and although other well-known methods of resuscitation may be applied, time should not be wasted on them before artificial respiration is commenced.



Current Literature.

(Continued from p. 76.)

¹*Congenital malaria.*—Cuadra, of Nicaragua, records the case of a woman, aged 26, with a past history of malaria, who gave birth to a child on January 19. The labour was difficult and forceps were applied. On January 21 the mother had an attack of shivering with a temperature of 104° F. The child's temperature also rose to 104° F., and examination of both the mother's and infant's blood showed the presence of *P. vivax*. The mother was treated by injections of quinine and the infant was given one cubic centimetre of euquinine by mouth every hour. Both recovered. Rabinoff also reports a case of congenital malaria in an infant a few hours old whose mother had suffered from chronic malaria with occasional acute exacerbations. Examination of the infant's blood showed tertian parasites. Quinine in one-grain doses every two hours was ordered. There was only a slight rise of temperature on the third day, and no recurrence took place.

In a paper on *malaria in children* at Smyrna, Veras states that though malaria is very prevalent throughout Asia Minor the town of Smyrna was relatively immune before the war, only three per cent of the children brought to his out-patient department from 1906-13 suffering from the disease, as compared with eleven per cent from June to December, 1920. The largest proportion of his cases occurred between the ages of 1 and 2 years. The form of malarial fever observed was the quotidian type, which is the most frequent at Smyrna. A characteristic tertian was met with in only eight out of eighty-eight cases seen between January and December, 1920. Veras never encountered the quartan type. Concetti's dictum that malaria in children has a greater tendency to chronicity than in the adult is confirmed by Veras, sixty-six of whose cases belonged to the chronic form. The liability of malaria to affect the nervous system in children was exemplified by the frequency of convulsions as an initial symptom and by the tendency of the disease to simulate meningitis. Gastro-intestinal disturbances were a frequent complication in young children, as in the cases observed by Rabinoff.

According to Rabinoff, who records her experiences of malaria among children in Palestine during 1918, the outstanding features of the disease in children are as follows: The chill is less frequently an initial symptom. On the other hand, there is a greater tendency to convulsions and other nervous symptoms, such as restlessness, twitchings, fretfulness or drowsiness. In children under 2 years gastro-intestinal symptoms are very frequent. The interval between the attacks is usually marked by a striking return to a normal appearance. Lastly, there is a much greater tendency to irregularity of temperature than in adults.

James states that among the civilians who contracted malaria in England between 1917 and 1919, no fewer than seventy-five per cent were children. In the great majority the symptoms were quite typical, but more severe than in most of the indigenous cases in adults. In some cases an irregular temperature and absence of characteristic attacks of shivering and sweating caused delay in diagnosis, and in a few the symptoms were so mild that the illness was not observed by the parents, but was discovered during special inspection of school children. James is opposed to the view that children suffer less severely from malaria than adults, and points out that in highly endemic localities the malarious children who appear on superficial examination to be healthy are those who after much chronic ill-health have succeeded in surviving repeated attacks until a

¹ Reprinted from *Medical Science*, vol. v. No. 2, November, 1921.

tolerance to the effects of parasitic invasion has been acquired. In places where children above the age of 10 show this tolerance the mortality among infants and children under 5 or 6 years of age is very high.

Malaria and Amœbiasis.—Job and Hirtzmann, after alluding to their previous papers on the frequent association of malaria and specific or non-specific intestinal disturbance (*vide Medical Science*, 1912, 1, 263), attribute this association to at least three factors, viz.: (1) the special susceptibility of the intestine in hot countries; (2) the frequent involvement of the intestine in malaria; (3) the predisposition which the malaria parasite and the dysentery bacillus create for one another. The amœba of dysentery and the malarial parasite also tend to combine their pathogenic effects. Malarial symptoms, however, do not usually occur simultaneously with those of amœbic dysentery, but malarial paroxysms appear as a rule during the decline of an attack of amœbic dysentery. The writers come to the following conclusions: (1) In a malarial country the association of amœbic dysentery and malaria is frequent. (2) It is most important not to overlook this combination. Although treatment by quinine and emetine will completely cure a certain number of cases, it is not infallible, and, in spite of energetic measures, intestinal or hepatic amœbiasis complicated by malaria is inevitably fatal in some cases.

Malaria and Syphilis.—Noel records a case of reactivation of syphilis by an attack of pernicious malaria and manifested by periostitis localized in the callus of an old fracture of the tibia.

Diagnosis.—Quarelli of Turin, records the results of his observations on about 600 cases in which he had employed provocative injections. The drugs used were adrenalin 1 in 1,000 solution, strychnine 3 to 5 milligrammes, 8 to 12 drops of 1 per cent alcoholic solution of nitroglycerine in 2 to 3 cubic centimetres of distilled water intramuscularly, emetine hydrochloride intravenously or intramuscularly in 12 centigramme doses and arsenobenzol 0.8 to 0.10 gramme intravenously. Antityphoid or antiparatyphoid vaccine subcutaneously, intravenous injection of ten cubic centimetres of horse serum, and intramuscular injection of ten cubic centimetres of cow's milk were also used. The most efficacious drugs for producing an attack were nitroglycerine, with which positive results were obtained in 72 per cent, emetine hydrochloride, and strychnine, with each of which attacks were produced in 59 per cent, and adrenalin, which was successful in 49 per cent.

Haider used benzol as a provocative agent for latent malaria as recommended by Henszelmann (*vide Medical Science*, 1919, 1, 264), but with entirely negative results, although he employed as large doses as 12 grammes per diem. In no case was the administration of the drug followed by a characteristic rise of temperature or a typical malarial attack with appearance of plasmodia in the blood.

Marx, who devotes his Paris thesis to a consideration of the Wassermann reaction in malaria, states that twenty-nine writers have published a more or less detailed account of the results of the reaction in 1,156 cases of malaria. Excluding two cases in which malaria was associated with undoubted syphilis, the number of positive cases was 322, or twenty-eight per cent. Out of 611 cases in which the reaction was tested during an acute attack, positive results were obtained in 274, or in 45 per cent. A positive Wassermann reaction does not appear to have been found in chronic malaria. The reaction remains positive for from about a month to six weeks after the acute attack. It is less frequently positive in malignant forms than in others. Occasionally it becomes negative as soon as the parasites disappear from the blood. As quinine appears to have a very definite influence in transforming a positive into a negative reaction, Marx recommends that in districts where malaria is particularly prevalent a positive Wassermann reaction in malarial subjects should not be regarded as evidence o

syphilis until after a quinine treatment of about six weeks (*vide also Medical Science*, 1919, 1, 61-2).

Treatment.—Johnson and Gilchrist made a statistical investigation of 18,731 cases of malaria returned from the German East African campaign and admitted to military hospitals in South Africa. The earlier records of this series frequently showed a dosage of quinine of five to ten grains daily, which was commonly associated with repeated relapses and progressive anæmia. In November, 1917, definite instructions for the routine treatment of malaria were issued, all ordinary cases, irrespective of type, being ordered ten grains of quinine in solution three times daily for three weeks, followed by the same dose twice daily for one month and then ten grains daily for two months. The increase in the number of days in which quinine was administered was associated with a reduction in the number of days in hospital. It was found that mixed infections of benign tertian and malignant subtertian were more resistant to treatment than either benign tertian or malignant tertian, and that benign tertian was as resistant or even more resistant than malignant tertian when the question of parasitological or clinical relapse was taken into consideration.

Macfie treated sixty-two native school boys, aged from 5 to 18, at Accra in the Gold Coast, West Africa, by oral administration of quinine sulphate ten grains daily for two consecutive days only. All the boys appeared to be healthy and were found to be infected with malignant tertian malaria only on blood examination. This dose of quinine was sufficient in every case to cause disappearance of the parasites from the cutaneous blood in one or two days. After this treatment parasites reappeared in the blood in the majority of cases. The percentage of parasitic relapses was highest in the age-group comprising boys from 12 to 14 years. Only one of the sixty-two boys was definitely known to have had a febrile relapse. Though possibly some of the youngest boys may have had malarial attacks which were not reported, the regularity of attendance at school of the majority of the boys showed that the amount of illness accompanying the large number of parasitic relapses was very small. The number of relapses both parasitic and febrile was less numerous than in the case of the young native children or the adult Europeans, but more numerous than in the adult natives, probably owing to a development of tolerance in the latter.

According to Johnson, Gilchrist, and Hay-Michel, neosalvarsan, salvarsan, neokharsivan, kharsivan, and galyl may be safely given intravenously in all forms of malaria if proper doses and precautions are observed. Those preparations exert a marked parasitocidal action on the benign tertian parasite, but have no definite parasitocidal action on any stage of the malignant subtertian parasite. Generally speaking, the tonic effects of these preparations is well marked in all cases of malaria. Anorexia, lassitude, and debility soon disappear, and splenic enlargement subsides with great rapidity. These preparations are of value in addition to quinine treatment in chronic resistant infections and malarial cachexia. Three or four injections at weekly intervals are recommended.

Brau and Marque, who record three illustrative cases, have found that while quinine, even in intravenous injections, has little effect against the resistant forms of *P. falciparum*, intravenous injections of novarsenobenzol appear to be specially indicated in cases of malignant tertian in which crescents predominate, the action of the drug being to arrest the febrile attacks and cause the disappearance of the crescents. Commenting on Brau and Marque's paper, Abrami and Senevet maintain that, though the various substitutes for salvarsan are in many cases good adjuvants of quinine in the treatment of malignant tertian, they cannot replace it. Moreover, it is indispensable, in studying the therapeutical action of a drug, to take into account the spontaneous course of the disease, especially in the cases of malaria in which the relapses occur at very infrequent intervals.

According to Salotti, who has treated twenty-three cases, neosalvarsan is a specific in the treatment of malaria which is refractory to quinine. In the first place it causes a rapid regeneration of the blood by its stimulating effect on the hæmatopoietic organs. Secondly, in acute pernicious malaria it is an excellent adjuvant to quinine, because it strengthens the patient's resistance. Thirdly, it enables quinine treatment to be suspended when this is of little benefit or produces symptoms of intolerance.

D'Esterre records 20 cases of recurrent malaria, 12 of which were benign and 8 malignant tertian, successfully treated by a course of four intramuscular injections of novarsenobenzol (neokharsivan) without any further recurrences being reported. The first two injections consisted of 0.3 gramme in 5 cubic centimetres 0.5 per cent sterile saline, and the last two injections of 0.4 gramme in 7 cubic centimetres 0.5 per cent sterile saline. The injections were given at intervals of a week.

A combination of intramuscular injections of quinine with subcutaneous injections of five to fifteen cubic centimetres of inactivated serum from carefully selected malaria convalescents is highly recommended by Seyfarth, who states that since he has employed this treatment he has had no fatal cases with the exception of two patients moribund on admission to hospital.

Sarailhé used the "sérum hémopoiétique" of Carnot in malarial anæmias with good results. The serum was obtained in the following way: Rabbits of average weight of just over three kilogrammes were carefully tested for parasites, etc. They were then bled to the extent of sixty cubic centimetres and this was repeated five days later. The serum obtained from the second bleeding by centrifuging was put in the ice-chest and used the following morning, not more than eighteen hours later. It was given intravenously in every case. The complete course comprises from 3 to 6 injections, the dose rising from 25 to 40 cubic centimetres. Fifty-three patients were treated, and none had a red cell count so high as 3,000,000. It was not uncommon for the injections to determine an attack of malaria with parasites in the blood some six or seven hours later.

Sarailhé claims that the good results are especially seen in the ensuing increase in the number of red cells, in weight, and in ability to sleep well, insomnia having been a troublesome feature in his cases. These results were quickly obtained and after only few injections, e.g., one a day for four successive days. It is also evident that the patients experienced much of the sudden increase of liveliness often seen after transfusions of blood. But the treatment is not curative of malaria and quinine therapy must be continued.

In four cases the treatment gave good results, but a rise in the number of red cells was no sooner obtained than it was destroyed by a malarial paroxysm. Certain cases of malaria were kept under observation as controls. Some of these showed quick rises in the number of red cells on quinine medication, but, by comparison with those who had serum treatment, were unable to maintain the increase in face of fresh malarial relapses. The serum cases, on the other hand, were found to maintain the position gained up to three months afterwards, this being the longest interval at which war conditions allowed the following of a patient.

Reviews.

MANIC-DEPRESSIVE INSANITY AND PARANOIA. By Professor Emil Kraepelin. Edinburgh: E. and S. Livingstone, 1921. Pp. xv. and 280. Price 15s. net.

To Professor Kraepelin of Munich we owe the generalization that mania and melancholia are different manifestations of the same mental disorder, and this author brings forward a large quantity of well-considered evidence to support his view. The crux of the question lies in the phenomena of the transition period between the manic and depressed phases in alternating cases, and in the mixed states.

Taking manic-depressive as a disorder of the domains of intellect, emotion and volition, Kraepelin brings forward cases in which the disorder of these three mental functions becomes, so to speak, dissociated in the transition period, with the result that patients may for a while be both excited and depressed. A patient may be excited, let us say, emotionally; at the same time he may be inhibited as regards intellect and volition, and so on. Sometimes a mixed state lasts a considerable time, for example, agitated melancholia.

The physiological idea of excitation and inhibition in the genesis of manic-depressive has been criticized, as it seems to lead to difficulties in the case of the transitional and mixed states. However, all such points are no doubt speculative at present.

The book includes an account of true or non-hallucinatory paranoia, a somewhat uncommon mental disorder. The author speaks for a very orthodox school of psychiatry, and a characteristic Freudian view of the genesis of paranoia is not mentioned. Indeed Freudian and related doctrine is not alluded to in the book at all.

Professor Kraepelin's work in psychiatry is renowned, and manic-depressive insanity one of his *chef d'ouvres*. The translator has done her work excellently, and her faithful translation of this section of Kraepelin's work is very welcome.

H. G.

TEXT-BOOK OF TRACHEO-BRONCHOSCOPY (Technical and Practical). By Sanitätsrat Dr. M. Mann. Translated by A. R. Moodie, M.A., M.D., Ch.B.St.And., F.R.C.S.Edin. With 50 illustrations and 5 plates in text and 10 coloured plates in the Appendix. Published by John Bale, Sons and Danielsson, Ltd., 1920. Pp. 263 and Appendix. Price 31s. 6d.

Although published six years earlier in Germany, this is the first appearance of this work in English.

The author considers that tracheo-bronchoscopy as a method of examination and treatment has never obtained the appreciation it deserves.

After a short discussion of the anatomy of the trachea and bronchi, the instruments used in this method are described in great detail. These are discussed under the various countries which have produced instruments for tracheo-bronchoscopy, and it would appear that our own country has done little in this respect, as it is not mentioned.

It is fairly clear that the Brünings apparatus, so much used in this country, is the most satisfactory type for universal use.

The preparation of the patient, the choice of anæsthetic and the technique of carrying out the examination are described in much detail, and the text is made clear by excellent illustrations.

The extraction of foreign bodies from the air passages is evidently considered the most important procedure, and eighty-four pages of the text are devoted to this subject.

The remainder of the text is devoted to tracheo-bronchoscopy in diseases of the bronchial system. This section includes many diseases such as bronchiectasis, asthma and diphtheria, when the use of the instrument is open to question, but the author puts the pros and cons fairly.

The text is rather overburdened in this section by short abstracts of illustrative cases.

The book gives a full presentation of this subject in a careful and accurate manner, but in such detail that it is not likely to be read by any but specialists on the subject.

As a book of reference it is of considerable value. The plates are beautifully reproduced, and give an excellent idea of the conditions described.

The translation reflects great credit on Dr. Moodie, and the book is very well produced by the publishers and free from typographical errors.

RADIOGRAPHIC TECHNIQUE. By T. Thorne Baker, A.M., I.E.E. London: Constable and Co., Ltd., 1921. Pp. xii + 196. Price 15s. net.

The author of this little volume has given the photographic side of the subject his main attention. The photographic technique supplied in the book is given in much detail and very clearly, and will be of much use both to radiologists and those engaged in the commercial side of radiography.

The preliminary chapter on X-ray installations is not written in sufficient detail, however, to be useful for instructional purposes in the Royal Army Medical Corps, while localization and stereoscopy, most important subjects in military X-ray work, is hardly gone into at all, and might have been left out.

Anyone wishing, however, to quickly grasp the physics and chemistry of radiographic exposure and development together with general radiographic photographic technique would do well to peruse this volume.

The little work is excellently produced and printed and the illustrations are good. We did not detect any typographical errors.

THE BURMA MEDICAL TIMES: A Monthly Medical Journal. Rangoon: Printed at the Swadesa Paripalini Press, and Published by T. D. Hari Rao, at 48, Sule Pagoda Road. Half-yearly subscription Rs. 3. Single copy annas eight.

Yet another new medical journal! It is getting more and more impossible to cope with the steady increase in medical literature. This time it is from Burma.

We welcome the *Burma Medical Times*, "the first and only one of its kind in Burma," as evidence of the progressiveness of the medical profession in Burma.

In the leading article "Ourselves" the journal makes its bow to the world and sets forth its good intentions. It hopes to appeal to medical men, sanitarians, chemists and druggists—to medical men by presenting "concise and carefully thought-out extracts of important articles from different medical journals," and by creating an *esprit de corps* (sic) among the medical brethren of this province by offering large money prizes from time to time for original and interesting articles; to sanitarians by being the medium for all constitutional warfare on their behalf in the promotion of sanitary reform; and to those engaged in the drug trade, by agitating against an alleged capitalist monopoly in the supply of drugs to municipalities.

This last object is presumably to be attained by publishing each month a list of drugs showing their comparative prices in England, India and Burma.

The sanitarians are catered for in the copy under review by a short article on "Infant Welfare in Burma," while the medical man is edified by an original article on "Rabies" from the pen of the Editor, Mr. T. D. Hari Rao and by some extracts from current medical literature.

The Editor realizes that, with the resources available, his journal cannot be

expected to contribute anything startling or original to medical science, hence it is only to medical men of the province that it can at present appeal by disseminating amongst them, up-to-date knowledge gleaned from other sources.

No doubt in time when Burma can boast of her own Institutes and Research Laboratories her literature will provide that element of originality without which it cannot expect to have any standing in the medical literature of the world.

J. C. K.

Correspondence.

PHYSICAL TRAINING IN THE ARMY.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—My letter asking officers to give their opinion on daily physical training for trained soldiers seems to have been rather misunderstood. I am not inquiring from a training point of view at all, but purely from the health side. Perhaps I shall make things clearer by asking—Are officers of opinion that the health of troops would be improved by the daily performance of physical exercises suitable to the station and climate in which they are located? Personally, I think it would, and that improvement would be shown in—

(1) A lessened sick-rate for disorders of the gastro-intestinal tract owing to the daily use of abdominal muscles with the consequent massage of intestines.

(2) The increased power of troops to undergo heavy work in an emergency, as the auxiliary muscles of walking, respiration, etc., would receive daily work and education.

(3) The lessening of fatigue and stiffness after heavy work, as the daily use of all muscles would keep the excretory system in training, and make the individual more economical in the use of food, oxygen, &c.

(4) Keeness in games, as the improvement of health would create restlessness which would find a natural outlet in further exercise.

I cannot agree with three of General Gubbins' remarks, i.e., (a) that men would be fed up with this daily physical training. If men were given interesting exercises and competition encouraged, I think the trained soldier would take an interest in the work and in his physical improvement. Of course, if officers, by example, teach the men to look on the work as a bore and a thing to be avoided, it becomes mechanical and almost useless. (b) That reservists would not continue the exercises in civilian life. Men are taught to be clean whilst with the colours and continue the practice in civil life, simply because it is comfortable, and so it would be with physical training. Thousands of civilians do physical drill daily for the feeling of well-being which it brings. (c) That London carmen make the best soldiers. I was sorry to see this remark repeated in one of the widely-read daily papers. My experience is that the English soldier, from whatever class he is drawn, becomes an almost true reflection of the officers with whom he chiefly comes in contact. A keen officer makes a keen soldier and vice versa.

I think General Gubbins supplies a very good argument in favour of, at any rate, trying to create a habit of daily physical training for the reservist to take into civil life, when he says "Six weeks on the veldt soon got them (the reservists) into form."

Anything we can do to shorten that six weeks must be all to the good of not only the Army but the Empire.

I am, etc.,

Chester,

December 6, 1921.

F. W. COTTON,

Lieutenant-Colonel R.A.M.C.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers. All these communications should be written upon one side of the paper only; they should by preference be type-written; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, S.W.1.

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Journal
of the
Royal Army Medical Corps.

Original Communications.

THE STANDARDISATION OF A BASE CULTURE MEDIUM.

By HENRY St. ARNAUD AGATE, M.C., ETC.

Temporary Major Royal Army Medical Corps.

Deputy Assistant Director of Pathology, Southern Area, Southern Command,

AND

LILLAH St. ARNAUD AGATE,

Laboratory Assistant.

It is impossible to reproduce artificially the exact environment in which a micro-organism, pathogenic or saprophytic, lives and multiplies in the human body, healthy or diseased.

From the dawn of the science of bacteriology it has been the practice to determine, by an empirical process of trial and error, the most favourable medium for the growth of a particular micro-organism or group of micro-organisms. The result is that the textbooks and technical papers of the present day are overloaded with the formulæ of countless media and their modifications, good for their particular purposes, and labelled with the names of their inventors or adaptors. In some cases the formulæ for a particular group alone are voluminous, an awful example being the "enterica group"!

We have dared to think that bacteriology, in the matter of media, has become involved in a mass of detail comparable with the traditional, unwieldy, and mostly unnecessary pharmacopœia of the mediæval (and later) physicians.

Human tissues and blood are much the same all the world over, and when a micro-organism obtains an entry, its living "culture medium" is practically a constant. From the fact that artificial cultivation of micro-organisms is possible, it must therefore be possible to construct a single artificial culture medium in which or on which all micro-organisms can

grow, given the temperature of the living body and the presence or absence of oxygen.

Let the construction of such a medium be considered as follows :—

- (1) The Reaction.
- (2) The Presence of Growth Substances (vitamins) [1].
- (3) The Content of Amino-acids [2].
- (4) The Content of Sodium chloride.

(1) REACTION.

This is expressed in terms of "pH" as follows: The letters pH are symbols, p means the power necessary to raise the figure 10 to express the contents in grammes (written g.) of hydrogen-ion per litre of a given solution. H means simply hydrogen-ion.

A normal solution of HCl (N/1 HCl) contains one gramme H-ion per litre and is written 1×10 to the power of zero. Decinormal HCl is written 1×10 to the power of minus 1, i.e., pH 1. The purest water contains 1 g. H-ion in 10,000,000 litres and is written 1×10 to the power of 7, i.e., pH 7; it also contains hydroxyl-ion in the same proportion, so pH 7 is designated as pure neutrality.

The minus powers of 10 are inverse logarithms, and as the solutions to be dealt with are far less acid than N/1 HCl, the minus sign in the pH figure is omitted for convenience.

The difference in reaction between pH 7 and pH 8 is a multiple of 10, i.e., pH 7 = 1 in 10,000,000 and pH 8 = 1 in 100,000,000. All solutions with a lower figure than 7 are more acid than water, i.e., H-ion concentration increases as the pH figure diminishes [3].

Then enters the question of fractions, pH 7 being ten times the acidity of pH 8, it is obvious that the gap is too wide and fractions must be used. It must be remembered that pH figures are logarithms and not simple numbers. To determine the relative difference in reaction between two pH figures with fractions, subtract the less from the greater and find the number of which the figure (or figures) on the right of the decimal point is (or are) the logarithm; this is easily done by referring to a table of logarithms.

Two examples will explain :—

The difference between pH 7.4 and pH 7.6 is 0.2; log. 0.2 is the number 1.59, so pH 7.4 is 1.59 times more acid than pH 7.6.

The difference between pH 6.6 and pH 8.0 is 1.4; log. 0.4 is the number 2.52, and as 1.4 has an integer (one figure on the left of the decimal point), the decimal point of the number must be placed one point to the right, so pH 6.6 is 25.2 times more acid than pH 8.0. The indicators used in the titrations which follow range from pH 6.6 to pH 8.0

As far as is known at present, the reaction of whole blood is about pH 7.5, and this reaction has generally been found by us to be the optimum for bacterial growth on or in culture medium.

Fluids containing organic acids, i.e., broths or solutions of peptones, possess (as does blood) properties known as "buffers." Buffers may be compared to the shock absorbers of motor cars; they can absorb small sudden additions of acid or alkali with the result of preventing an immediate change in the reaction of the whole organic fluid such as would occur in a simple HCl or NaOH solution. This makes the titration of a culture medium a very delicate operation, the colour change of the indicator being sudden when the absorbent power of the buffers is exhausted.

The effect of sterilization on reaction is dealt with later.

(2) THE PRESENCE OF GROWTH SUBSTANCES.

A small amount only is necessary. Many substances have been tried—dried and green peas, haricot beans, soy beans, egg yolk, pea flour, and others, and all unsatisfactory from the technical point of view (precipitation on sterilization, etc.). Finally a preparation called "marmite" was tried (a vegetable extract largely used in the East during the war for its vitamin content) and proved satisfactory.

(3) THE CONTENT OF AMINO-ACIDS.

This is estimated by the formaldehyde method, and is conveniently measured in terms of decinormal NaOH per cent.

The medium is built up from meat broth and dry peptone, as follows:—

A bullock's heart is cleaned of fat and fibrous tissue, put through a mincing machine, the mince is mixed with twice its weight of distilled water and made slightly alkaline to litmus paper. It is heated to 80° C. for five minutes and cooled to 37° C., when to the total volume, Liq. trypsinæ co., in the proportion of one per cent., is added. It is incubated at 37° C., and the biuret reaction tried at intervals of some hours, the time required to give a positive reaction (pink) being very variable. When the reaction is positive, the mass is strained through a wire gauze sieve and then through glass wool, sterilized at 100° C. for thirty minutes, and allowed to cool. The reaction is then generally found to be acid—if not, it must be made acid to litmus paper with N/1 HCl. After standing for twelve hours, any fat is removed from the surface with coarse filter paper. It is again subjected to 100° C. for thirty minutes, cooled and decanted. The reaction is adjusted and the amino-acid content estimated by means of a comparator and indicators as follows:—

The comparator is a box to hold six test tubes in two rows of three with black divisions between each pair and slits in the front through which each pair can be seen; the tubes are half inch by five inches, selected to contain ten cubic centimetres at exactly the same level, and are the same size as those containing the indicator colours. The one we use was made from cleaned cigar-box wood with a fret-saw glass-paper, glue, and stained dull black with straw-hat stain, a front of ground glass was also fitted.

The indicators are sealed tubes containing solutions of phenol-red with a reaction ranging from pH 6.6 to pH 8.0 in steps of 0.2 (Baird and Tatlock).

A solution of phenol-red 0.01 in distilled water is prepared.

Decinormal NaOH is run into a fine burette (graduated in 100ths of one cubic centimetre), fitted with rubber-tube continuation and finger clip, and ending in a finely pointed glass tube, drawn out to deliver tiny drops. Decinormal HCl is also prepared in the same way.

Let the tubes in the comparator be designated thus:—

Back row	A	B	C	
	○	○	○	
Acid side (+)				Alkaline side (—)
Front row	D	E	F	
	○	○	○	

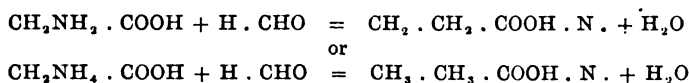
To get a preliminary idea of the reaction of a given fluid, put ten cubic centimetres plus one cubic centimetre water into tubes D and F, and ten cubic centimetres plus one cubic centimetre 0.01 per cent phenol-red into tube E. By using the colour standard tubes in places A and C and water in tube B, it is easily seen on which side of pH 7.0 the reaction of the fluid lies.

To adjust the reaction of the broth proceed as follows: Tube A is replaced by indicator tube pH 7.4, tube C by indicator pH 7.6, and tube B is filled with distilled water. Tubes D and F each receive one cubic centimetre of water plus ten cubic centimetres broth, and tube E receives one cubic centimetre 0.01 per cent phenol-red plus ten cubic centimetres broth. The N/10 NaOH is then run drop by drop into tube E (inverting the tube after each addition) until the colour in it is midway between that in tubes D and F, when looking through the comparator held before a sheet of white paper stuck to a window. The volume of N/10 NaOH used is the amount of N/1 NaOH per cent necessary to render the reaction of the broth to pH 7.5. The broth is then measured, the N/1 NaOH added, and the whole well shaken.

The estimation of amino-acids is now proceeded with. Tubes D, E, F are emptied and washed out, D and F are filled with water and E receives one cubic centimetre of 0.01 phenol-red plus ten cubic centimetres forty per cent formaldehyde solution. N/10 NaOH is dropped into tube E until the colour is again between that in tubes D and F. It is necessary to have a well-fitting soft cork for tube E in order to avoid damage to the skin of the thumb or finger while repeatedly inverting the tube, as also later when working with hot medium. The contents of tube E are then poured into a wide test tube and ten cubic centimetres of the adjusted broth plus 0.01 cubic centimetre phenol-red are added and the mixture well shaken. The colour now goes to the left (acid side) of pH 6.6, and the mixture consists of ten cubic centimetres broth, ten cubic centimetres formaldehyde, and two cubic centimetres 0.01 phenol-red, which has undergone a chemical change rendering the amino-acids capable of estimation. Eleven cubic centimetres of the mixture are put into the washed tube E, which now contains five cubic centimetres broth, five cubic centimetres formaldehyde

(after chemical interaction) and one cubic centimetre 0.01 phenol-red (the regular amount of volume and indicator). As tube E now contains five cubic centimetres broth, it is necessary to wash out tubes D and F and put five cubic centimetres broth plus six cubic centimetres water into each in order to maintain the colour translucence (eleven cubic centimetres volume). N/10 NaOH is then run into tube E until the midway colour is again obtained. The volume of alkali required is the amino-acid content of the broth in terms of N/10 NaOH per cent.

The inter-action of the formaldehyde-broth mixture (each at the reaction of pH 7.5) may be shown by the equation :—



A two per cent solution of dry peptone, a one per cent solution of marmite, and a three per cent solution of agar powder are treated in exactly the same way, and a label stating the amount of N/1 NaOH per cent necessary to render to pH 7.5, and the actual amino-acid content, is pasted on the bottles containing the samples from which these experimental solutions were made. This saves future estimations until a new sample is used.

(4) THE CONTENT OF SODIUM CHLORIDE.

This is fixed at 0.85 per cent of the final volume of the constructed medium. It does not affect either reaction or amino-acid content.

THE EFFECT OF STERILIZATION ON REACTION.

A newly-made broth, peptone solution, etc., adjusted to a definite pH, is more acid after sterilization, especially if a temperature of more than 100° C. has been employed. It was found by repeated experiments that the increase of acidity becomes less and less with each sterilization at 100° C. for thirty minutes on successive days. It was then found that if, before any titration or adjustment was done, the broth, etc., were repeatedly sterilized as above, the reaction does not alter after subsequent similar sterilization when adjustment to pH 7.5 has been done.

All new broths, solutions, etc., are now treated in this way.

FILTRATION.

Filter paper is not used, only glass wool and gauze. It was found that filtration through paper was not only too slow but also caused a surprising diminution in the amino-acid content. As the various solutions are not titrated in any way before filtration and repeated sterilization, then decanting, gauze, and glass wool are found to give a sufficiently clear medium. Clarification by means of egg white and other methods has been abandoned; it seems evident that a medium so treated and put through filter paper loses much of its amino-acid and other content, possibly by adsorption. With both liquid and solid media a control (uninoculated) tube or

plate is always associated during incubation (the control is not usually wasted), thus giving a comparison in translucency. It may be added that before passing all tubes and plates of the completed media to store they are incubated for twenty-four hours and the doubtful ones rejected (and they are few).

IN PRACTICE.

In each of the following examples the procedure detailed above is strictly observed :—

A tripsinized ox heart broth required 2·3 cubic centimetres N/1 NaOH per cent to bring to pH 7·5, and when adjusted the amino-acid content was 96 per cent.

A 2 per cent solution of dry peptone required 0·4 cubic centimetre NaOH per cent to bring to pH 7·5, and when adjusted the amino-acid content was 34 per cent.

A 1 per cent solution of marmite* required 0·5 cubic centimetre N/1 NaOH per cent to bring to pH 7·5, and when adjusted the amino-acid content was 10 per cent.

It is only necessary now to reckon up the amino-acid values, add enough distilled water to get a total amino-acid content of forty per cent, and then add 0·85 per cent NaCl to the volume, to obtain the base medium.

Two estimations must be recorded also :—

A solution of 3 per cent agar required 0·05 cubic centimetre N/1 HCl per cent to bring to pH 7·5.

A solution of sodium taurocholate required 0·075 cubic centimetre to bring to pH 7·5.

The amino-acid content of these two solutions is negligible, and the containers of the samples from which the solutions were made are labelled.

When solid medium is made from the fluid base, after the solution of the agar (3 per cent) at 100° C. filtration (as before) is done and the necessary 0·05 cubic centimetre N/1 HCl is added. For accuracy the medium can be titrated at a temperature of 65° C., in the comparator as described under heading (3), the reaction and amino-acid content being thus again estimated and any necessary adjustment made. We have found that re-adjustment is rarely required.

ADMIXTURES.

It then becomes necessary to add one or more substances to this base medium in order that the metabolic activities of micro-organisms may be observed, the isolation and ultimate identification of a particular micro-organism (or group) be made possible, the growth of one particular micro-organism (or group) be encouraged at the expense of another, and one isolated micro-organism be given its optimum environment for massive growth, for the economical preparation of suspensions.

(a) Admixture of agar (three per cent) to make the medium solid.

(b) Admixture of blood constituents (whole blood, plasma and serum).

(c) Admixture of fermentable substances, monosaccharides, disaccharides, trisaccharides, polysaccharides, glucosides, and polyatomic alcohols.

(d) Admixture of cubes of gelatine, white of egg, solidified blood serum, and sterile kidney.

(e) Admixture of sodium taurocholate, brilliant green, telluric acid, soy-bean extract, and other substances found by experiment to be useful.

(f) Admixture of an indicator.

(g) Admixture of an inverted glass tube.

Any one or combination of these seven groups of admixtures may be added to the base medium.

(a) Admixture of agar in the proportion of three per cent forms a good working consistency. There is no reason why the solidified medium should be so jelly-like that it shivers and is scratched at the touch of a platinum loop.

(b) Admixture of (b) (defibrinated blood five per cent) and (a) demonstrates hæmolysis and encourages the growth of streptococci, meningococci and hæmophylic micro-organisms. Admixture of (b) (plasma twenty per cent), (a) and (c) (glucose) encourages maximum growth of gonococci. Admixture of (b) (serum twenty per cent), (c) (lactose, glucose, maltose, mannite, and salicin in series), and (f) gives a scheme for differentiating streptococci [4]. Admixture of (b) (serum twenty per cent), (c) (glucose, maltose, and saccharose, in series), and (f) gives a scheme for differentiating diphtheroids [5].

(c) Admixture of (c) (1 per cent in series), (f) and (g) demonstrates the production of acid and gas. Production of indol depends on the presence of peptone, and is demonstrable in fluid base medium without admixture, the test being paradimethylamidobenzaldehydehydrochloric acid-alcohol solution with heat.

(d) Gelatin (fifty per cent), white of egg, and blood serum may be solidified in sheets in deep Petri dishes at suitable temperatures, cut into cubes, and dropped into tubes of base medium to demonstrate liquefying and digesting properties. A cube of sterile kidney added to the base medium gives a combination for Noguchi culture.

(e) Admixture of sodium taurocholate (0.5 per cent), brilliant green (1 in 250,000), telluric acid (1 in 25,000), thallium acetate, and other substances found by experiment to be of use, gives a selective medium for the differentiation of various groups of micro-organisms. A medium for the routine "plating out" of fæces is an admixture of (a), (c) (lactose), (e) (sodium taurocholate), and (f).

(f) The indicator used is a mixture of brom-cresol purple and cresol red [6]. Two stock solutions of 1.5 per cent in absolute alcohol are made and stored in the dark. To 100 cubic centimetres of medium 0.2 cubic centimetre of each solution is added, giving a light port wine colour to liquid medium and the same colour to solid medium by reflected light, or

when in bulk; a thin layer in a Petri dish viewed by transmitted light shows a greenish purple colour, but by reflected light the port wine colour.

The metabolic production of acid by the growth of a micro-organism in liquid medium gives a uniform yellow colour; the same on solid medium gives a yellow colony with a yellow zone, a non-acid producing micro-organism gives the same colour as the medium, and an alkaline producer gives a purple colony with a purple zone.

Brom-cresol purple has a range of pH 5.2 to pH 6.8 and cresol red a range of pH 7.2 to pH 8.8, thus together ranging from pH 5.2 to pH 8.8 with a convenient gap of two decimal points on either of absolute neutrality (pH 7.0.)

(g) The Durham tube for the demonstration of the production of gas in liquid medium with admixture C needs no explanation.

CONCLUSION.

For nearly three years past this medium (made increasingly accurately as more experience by experiment and more knowledge from current technical literature were gained) has been used in routine and research work. It has been used in parallel with the very numerous media of the textbooks, with special media such as the tryptagar and catarrhal media issued by the Royal Army Medical College, and other media put forward by various authorities.

During the use of this medium for over three years for every culture made, in no case did it fail, and in the majority of cases gave a better growth in less time than the control on textbook medium. With admixtures when necessary and the presence or absence of oxygen at a temperature of 37° C. we claim that it is a reliable constant standardized medium, whether made in successive batches when needed, or in large bulk for storage or distribution.

We are convinced that only by standardization of technique can comparable (the only valuable) results be obtained, and we have attempted to standardize the bed-rock (the culture medium) upon which broad-based, comparable results can stand.

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SEROLOGICAL AND MORPHOLOGICAL CHARACTERISTICS OF THE PNEUMOCOCCUS.

(AN ANALYSIS OF ORGANISMS ISOLATED FROM SEVENTY-SEVEN
CASES OF PNEUMOCOCCAL INFECTIONS.)

By A. L. URQUHART, O.B.E., M.B., CH.B. EDIN., D.P.H.

Late Major, Royal Army Medical Corps.

*Senior Assistant Bacteriologist, St. Thomas's Hospital, London; Gillson Scholar
in Pathology of the Society of Apothecaries, London.*

In April, 1920, Sir Frederick Lister forwarded from the South African Institute for Medical Research some of his standard strains of pneumococci, with their homologous antisera, which he had isolated from cases of lobar pneumonia occurring in the mining area, in order that they might be compared with strains of pneumococci present in this country.

In this communication comparison has been made with pneumococci isolated from cases of lobar pneumonia, and with those obtained from cases of pneumococcal infection other than lobar pneumonia.

These results have also been correlated with those of the Rockefeller and other workers by means of Rockefeller antipneumococcal sera, so that it was possible to compare the results obtained with those of Lister and American workers.

The South African standard strains forwarded by Sir Frederick Lister were his groups A, B, C, E, F, G, J and K, and were transmitted by the following method. Defibrinated rabbit's blood was inoculated with the pneumococcus, and the culture incubated for eighteen hours. The blood was then dried in vacuum over sulphuric acid, and the resulting scaly preparation sealed in vacuum in a tube. After a month the tubes arrived in London, and the powder was plated on blood agar. Groups E, G and K failed to grow, but the remaining groups A, B, C, F and J, grew well.

As the systems of nomenclature used by Sir Frederick Lister and by the Rockefeller workers differ, it may be well here to correlate them in order to avoid confusion, and to give some comparative figures of the percentage of the strains of pneumococci found by these workers.

Lister has separated the pneumococci isolated by himself over a period of five years into twelve groups, giving each group an alphabetical index; while the Rockefeller nomenclature contains types I, II, and III—the "fixed" types of cocci—and type IV which contains the strains which do not fall into the first three types. It is well recognized, however, that type IV is a heterogeneous collection of strains capable of being divided into numerous sub-groups.

The following list gives the relationship between Lister's nomenclature and that of the Rockefeller workers:—

Lister's group		Rockefeller type
C	=	I
B	=	II
E	=	III
A, D, F, G, H, J, K, X, and unclassifiable	=	IV

In some of the figures quoted below it will be seen that type II Rockefeller has been further subdivided, and types IIa, IIb, and IIx are noted which agglutinate slowly and incompletely with standard type II antiserum.

Lister (1917), giving his percentage figures for the strains of pneumococci isolated from cases of lobar pneumonia, states that group A, 31 per cent of the total, is the type most frequently isolated from the native workers; group C (type I, U.S.A.), 21·6 per cent; group B (type II, U.S.A.), 16·2 per cent; group E (type III, U.S.A.) 1·3 per cent; and the remaining groups, D, F, G, H, J, K, X, and unclassifiable (type IV, U.S.A.) form eight small groups which account for the remaining 30 per cent of the infections.

This A group has been investigated by A. R. Dochez, of the Rockefeller Institute, and has been placed by him amongst the type IV cocci; it appears to be unknown in America, although it is the most frequently isolated organism in South Africa. During this investigation five strains of this A group have been isolated in this country.

Cole (1913), giving his analysis of the strains of pneumococci in 500 cases of lobar pneumonia, states that one-third are type I, one-third type II, 10·15 per cent type III, and the remainder of the infections are due to type IV pneumococci.

With regard to the grouping of pneumococci isolated from infections other than lobar pneumonia, Meyers (1920), giving the results of the examination of 100 normal throats, found pneumococci present in twenty-one instances. Types I and II were not represented in these strains, one belonged to type IIa, a sub-group of type II, three to type III, and the remaining seventeen to type IV. The same paper quotes Stilman's figures who, from 297 persons suffering from conditions other than lobar pneumonia, isolated pneumococci in 116 cases. Of these type I pneumococcus was present in 0·8 per cent; type II, IIa and IIb, none; type IIx, 18·2 per cent; type III, 28·1 per cent; and type IV, 52·9 per cent. Cooper, Misholow, and Blanc (1921), working more especially with pneumococci responsible for common cold and influenza, state that of 43 strains isolated 9 are of "fixed" type, *i.e.*, type I 3, type II 2, type III 4 strains. Fifteen strains showed slow agglutination to type II antiserum, while the remaining nineteen cocci belonged to type IV. These IIa, IIb, IIx, and slow agglutinating type II strains of pneumococci are sub-groups of the Rockefeller type II.

Of the seventy-seven strains of pneumococci noted below, thirty-three have been obtained from cases of lobar pneumonia. Seventeen belong to group C Lister (Rockefeller type I), 8 to group B (type II), 2 to group A and 6 to type IV, but unrelated to Lister's subgroups G, F, J or K. The remaining 44 strains, obtained from other sources, i.e., broncho pneumonia, bronchitis, meningitis, cold, etc., 14 are type I, pneumococci, 3 type II, 3 group A and 24 type IV.

These results are somewhat similar to those of Lister and the American workers, groups C and B, i.e., types I and II pneumococci accounting for a large percentage of the lobar pneumonias, while in the case of cocci isolated from other conditions over fifty per cent belong to type IV.

Lister's group E, Rockefeller type III, has not been isolated during this series, and the F, G, J and K strains forwarded by Lister have not been found among the cocci composing type IV.

LABORATORY METHODS EMPLOYED DURING THESE INVESTIGATIONS.

All cultures of pneumococci were grown aerobically at 37° C.

(a) *Media*.—Blood agar, as slopes and plates, has been used for the isolation and cultivation of the pneumococci. For slopes 0.4 cubic centimetre of whole oxalated human blood was added to five cubic centimetres of melted agar at a temperature of 45° C. The tubes were rolled to mix the blood and re-sloped. For plates one cubic centimetre of whole blood was added to ten cubic centimetres of agar as above. The blood for making this medium was obtained by venipuncture, some ten cubic centimetres of blood being taken into a sterile tube containing about 0.03 gramme of powdered potassium oxalate. The tube was inverted several times and this oxalated blood stored on ice.

(b) *Sugar Media*.—Lactose, glucose, mannite, saccharose, starch, salicin, inulin, and inosite, have been employed as a one per cent solution in sugar free nutrient broth. To five cubic centimetres of the medium 0.5 cubic centimetre of sterile human blood serum was added before inoculation. Decolorized acid fuchsin was used as the indicator. The reactions were recorded daily, but the final readings were made on the fifth day. Litmus milk was also employed as a test substance.

(c) *Evidence of Hæmolysis Test*.—To five cubic centimetres of peptone water 0.1 cubic centimetre of human red cells was added; the tubes were inoculated and incubated for twenty-four hours at 37° C. The presence or absence of hæmolysis above the sedimented red cells was noted. The peptone water was made up in two series, one containing 0.5 per cent, the other 0.85 per cent of sodium chloride, and each strain was tested on the two percentages of saline.

(d) *Bile Salt Lysis*.—Two methods have been employed.

Method I: On a glass slide two films of the culture were made, A and B. The films were separated by a double grease pencil line. To film A distilled

water, and to film B a two per cent solution of sodium taurocholate in distilled water was added, and allowed to act for fifteen minutes. The films were then washed, and stained with carbol thionin. On examination, film A acted as control, film B showing the presence or absence of lysis. The above method has been replaced by Method II. A five cubic centimetre tube of sugar free broth, to which a few drops of sterile serum have been added, was inoculated and incubated at 37° C. for twelve hours. The culture was divided into two portions. To the first an equal quantity of broth was added, to the second an equal quantity of four per cent solution of sodium taurocholate in distilled water. The tubes were examined after fifteen minutes at laboratory temperature for the presence of lysis in the taurocholate tube. The broth tube which retained its original opacity acted as a control, the taurocholate tube becoming clear or almost clear when lysis occurred.

- The second method has been found more satisfactory but it is necessary that the taurocholate solution and the broth should be of the same depth of colour, while if too much serum is added, after incubation a haze will be produced in the culture which will mask the true reading of the test.

(e) *Hæmocultures*.—The blood for this purpose was obtained by venipuncture. Five to eight cubic centimetres of blood were taken into twenty cubic centimetres of glucose broth and distilled water. The cultures were incubated at 37° C. for at least three days, subcultures being taken at suitable intervals. It has been noted that the distilled water medium, i.e., a hæmoglobin medium, was more satisfactory, a distinctly heavier growth being obtained after incubation, but on no occasion was a growth obtained in this medium and absent in the glucose broth medium.

(f) *Agglutination and Phagocytic Test*.—The technique is similar to that employed by Sir F. S. Lister (1913) who adopted a modification of the opsonic method introduced by Sir A. Wright (1912).

- (1) The pneumococci were grown for twenty-four hours on blood agar.
- (2) The emulsions of cocci were made in normal saline.
- (3) The blood corpuscles were obtained by pricking the finger. The blood was collected in five per cent citrate, or citrated saline, and the mixture centrifugalized; the deposited corpuscles were washed twice in normal saline.
- (4) The sera were collected from cases by venipuncture, or were rabbit antipneumococcal sera.
- (5) The phagocytic mixtures consisted of equal volumes of blood corpuscles, emulsion of pneumococci and serum.
- (6) The phagocytic mixtures were incubated at 37° C. for fifteen minutes.

METHOD OF EXAMINATION OF THE INCUBATED MIXTURE.

Films of the incubated mixtures were made, and after fixation, in saturated aqueous solution of perchloride of mercury, stained with carbol

thionin. Later this method was modified, and the mixture, after being gently drawn up and down the capillary tube, was blown out on a glass slide. A drop of this mixture was made into a thick film, as suggested by Sir Ronald Ross for examination of blood for malarial parasites.

This thick film was dried, dehaemoglobinized in distilled water, and stained with carbol thionin. This modification has the advantage that clumps of cocci are not broken up as in the spreading method, and that three or four preparations may be made on the same slide.

On examination of these preparations in cases where a negative result was obtained, the pneumococci were found scattered evenly throughout the film, practically no phagocytosis by the polymorphs taking place. Where a positive result was obtained the cocci were found in large agglutinated masses, seen best at the tail of the film in the first method noted above, and grouped throughout the thick film in the second method. Phagocytosis of the pneumococci by the polymorphs in such positive preparations is a striking feature of the film.

The phagocytic power of the antipneumococcal sera prepared from rabbits which was sterilized with 0.5 per cent chloroform gradually fell off, and this phenomenon could not be observed after the serum had been stored for some months. The opsonic power was not restored by the addition of fresh normal serum.

(g) *Anti-pneumococcal sera*.—Anti-sera were prepared by the inoculation of rabbits with increasing doses of heat-killed vaccines of pneumococci grown on blood agar. The interval between the doses was five days and the doses ranged from 250 million to 6,000 million cocci. The rabbit's serum was tested after each inoculation, and when a satisfactory anti-serum was obtained the animal was anaesthetized, the axillary artery exposed and severed, and the blood collected in a sterile bottle. When the serum had separated it was removed and sterilized by adding 0.5 per cent of chloroform and heating to 40° C. in a well-corked bottle for one hour.

ISOLATION OF PNEUMOCOCCI FROM PUS AND SPUTUM.

Pneumococci were obtained in pure culture from haemocultures, but when sputum or pus was examined the organism was one of several present in the specimen, and although by looking at stained preparations of such material one could detect the typical capsulated pneumococci in large numbers, it was found to be very difficult in many cases to separate them from the other organisms present.

For some time past Dudgeon's method (Wordley, 1921) has been employed, and has given most satisfactory results. Unglazed porcelain tiles 3 in. by 3 in. sterilized by heat, were spread with the pus or sputum. The excess of moisture was rapidly taken up by the tile, and the resulting sticky mass was transferred to a second tile, spread out and left to dry to a flaky powder (one to three hours).

The powder was scraped from the tile, and a quantity spread on a blood agar plate which was then incubated.

By this means it was possible to get a plate on which the colonies were well separated, even although the original material contained many types of organisms. In specimens in which the types of organism are few, blood agar slopes have been used in place of plates with satisfactory results. It is necessary to employ a glass screen mentioned by Wordley in his description of the method for the protection of the worker, as the powdered sputum is a dangerous source of infection, and in several instances contained the tubercle bacillus.

MORPHOLOGICAL AND CULTURAL CHARACTERISTICS OF THE PNEUMOCOCCUS.

The morphological and cultural characters of the pneumococcus noted in this paper have been examined. The typical appearance of the pneumococcus, a Gram-positive capsulated diplococcus pointed toward the free ends, and broader at the opposed surfaces, is best made out in fresh films of pus or sputum.

It has been noted by many observers that these typical appearances may rapidly disappear on culture, and—by the loss of capsule formation and the occurrence of chain formation such as is frequently seen in cultures in liquid media—the pneumococcus may become indistinguishable from the streptococcus.

In fluid cultures the pneumococcus forms a cloud throughout the medium, and on blood agar the colonies are discoid and slightly granular. After twenty-four hours the colonies and the blood medium become brownish or greenish brown, and this colour deepens with the age of the culture. Park and Williams (1905) have noted that this green colour is present in atypical colonies, but may also be absent in typical strains.

The cultural reactions of seventy-seven strains of pneumococci have been noted on lactose, glucose, mannite, saccharose, starch, inulin, salicin, inosite, and litmus milk, the "sugar" media all containing 0.5 cubic centimetre of blood serum. The action on mannite, salicin, and inulin was variable, some strains producing acid, some having no action on the "sugars." Inosite was not fermented in any case. The remaining "sugars" and litmus milk were acidified in every instance.

These strains of pneumococci were members of different serological groups, but no indication of grouping could be obtained from the fermentation reactions on the above mentioned substances.

Twenty-eight strains of streptococci, obtained from various sources, have been tested in the same way, and in many instances similar reactions to those of the pneumococci were recorded. From these observations and those of Cole (1913), Dochez and Gillespie (1913), Logan (1921), and Cooper, Mishulow and Blanc (1921), all of whom have obtained somewhat similar results, one comes to the conclusion that as a means of classification of pneumococci the fermentation tests are of no value.

LONGEVITY OF PNEUMOCOCCI IN CULTURE MEDIA.

It has been noted above that five of the eight standard strains of pneumococci sent by Sir F. S. Lister from South Africa, in dried rabbit blood survived one month, that is during the period of transmission from Johannesburg to London. It has been further noted that three of these cultures were still living and were subcultured four weeks later.

These stock strains, and certain strains isolated here, have been subcultured on blood agar weekly, and kept at 37° C, but frequently, although not always, sub-cultures taken from blood agar slopes fourteen days old gave satisfactory growths.

In the "sugar" media, if fermentation has taken place, the pneumococci can rarely be recovered from the acidified medium after a period of three days, but if no fermentation has taken place the pneumococci will survive up to two months; survival may be longer, but my own observations have not extended beyond this period.

HÆMOLYTIC ACTIVITY OF THE PNEUMOCOCCUS.

All strains of pneumococci noted below have been examined as to their power of hæmolyzing human red cells. In all but two instances negative results have been noted, and these two exceptional strains have been included for the following reasons.

(1) The organism, No. 132, Table I, was obtained from a corneal membrane in the eye of a baby aged five months. Morphologically the organism was a typical capsulated Gram-positive diplococcus, which lysed in bile salt solution after subculture, and agglutinated powerfully with type I antipneumococcal serum.

(2) The organism, No. 107, Table II, was obtained from the sputum of an asthmatic subject. Morphologically the organism was a typical capsulated diplococcus, which lysed completely in bile salt solution, and agglutinated powerfully with type II antipneumococcal serum.

Hæmolytic activity would appear therefore to be a rare characteristic of the pneumococcus, only two of a series of seventy-seven strains tested exhibiting this property.

THE ACTION OF TWO PER CENT SODIUM TAUROCHOLATE ON THE PNEUMOCOCCUS.

All strains of pneumococci noted below have been subjected to the action of two per cent bile salt solution by one or other of the methods noted above. Dochez and Gillespie (1913) state that all strains of pneumococci are bile soluble except type III, or become soluble on subculture. Two of the strains noted below have presented this feature, one No. 132, Table I, noted in a previous paragraph, see (1) above, and the second a type IV pneumococcus, No. 126, Table III, which was isolated from the cerebrospinal fluid of a case of pneumococcal meningitis. On subculture

the cocci lysed completely in bile salt solution, although when first isolated a negative result was obtained to this bile salt test.

Armstrong (1921) in his description of the pneumococcus, notes that he has found a group of organisms morphologically resembling the pneumococcus which are bile soluble, but which will not emulsify in saline. Four organisms apparently similar to those isolated by Armstrong have been found among those isolated during this work, all being bile soluble, but none would emulsify in saline, so that their agglutinative characteristics could not be investigated.

RESULTS OF BLOOD CULTURE IN PNEUMOCOCCAL INFECTIONS.

Blood cultures have been made in cases of pneumococcal infections during the pyrexial period, nutrient glucose broth and distilled water being used as the culture media. White (1899), in giving results of blood cultures made in cases of pneumonia, quotes figures given by several workers. Stillman, examining 18 cases of pneumonia, obtained 6 positive cultures; in 2 of these the cocci were seen in blood films only, and did not grow in the culture media. Of 12 cases in which negative blood cultures were obtained 2 died; of 6 positive cases 4 died. Kohn, in 32 cases, found the pneumococcus in the blood of 9 cases, of which 7 died and 2 recovered. Of 13 negative cases (including 2 cases dying of complications) 8 recovered. At a later date he found that a considerable majority of the negative cases recover, whilst a similar proportion of the positive cases die. He concludes that the presence of the pneumococcus in the blood gives a very unfavourable prognosis. White found that of nineteen cases of lobar pneumonia, all at least moderately severe, ten were fatal. Thirty-two blood cultures were made, and in three cases the pneumococcus was found in life. In two of these positive cases general pneumococcal infection was found post mortem. In eight cases with negative blood cultures, although the pneumococcus was present in the lungs, no evidence of a general pneumococcal infection was found post mortem.

Thirty-four blood cultures were made during this work, and of these 19 were positive and 15 negative. The pneumococci have been typed and are distributed as follows:—

Rockefeller nomenclature		Lister's nomenclature		Number of blood cultures		Positive		Negative
—	..	Group A	..	2	..	1	..	1
Type I	..	„ C	..	20	..	8	..	12
„ II	..	„ B	..	7	..	5	..	2
„ IV	..	Unclassified	..	5	..	5	..	0

In Lister's Group A two patients were examined by blood culture, one, a case of lobar pneumonia with empyema (positive) died; the other, a case of broncho-pneumonia (negative) recovered.

In type I the eight positive results were obtained in 5 cases of lobar pneumonia, 2 of meningitis, and 1 of septicæmia. The negative cultures occurred in 10 cases of lobar pneumonia, 1 of broncho-pneumonia, and 1 of

chronic empyema. Of these 8 positive blood culture cases, 5 died, 2 of lobar pneumonia, 2 of meningitis, and 1 of pneumococcal septicæmia. Of the 12 cases in which negative blood cultures resulted 2 died, 1 of lobar pneumonia, and the other of a chronic empyema associated with advanced waxy disease.

In type II the 5 positive blood cultures were all obtained from cases of lobar pneumonia, while 1 lobar and 1 broncho-pneumonia gave negative results. Of the five positive cases two died; both negative cases recovered.

In type IV, 5 positive cultures were obtained, 3 from cases of lobar pneumonia, and 2 from pneumococcal meningitis. Both meningitis cases and one of the pneumonia cases died.

In all cases in which a positive culture was obtained, the examination was made within seven days of the onset of the disease, and it is noted that of the four cases of meningitis examined all had positive blood cultures and all died. In the cases where a negative culture resulted, 7 were made during the first week of illness, 4 during the second week, 1 during the third, 2 during the fifth, and 1 from a chronic empyema established for seven years in which a pyrexial condition was present.

In those cases of pneumonia with pyrexia during the third and fifth weeks an empyema was present.

From an examination of these results it will be seen that of 19 positive blood cultures death resulted in 11 cases, whereas in 15 cases where a negative blood culture was obtained 2 died, one a case of lobar pneumonia which died on the eighth day, the other a case of chronic empyema with advanced waxy disease.

Although the number of cases examined by blood culture is small, it would appear that in cases of pneumococcal infections a positive blood culture is of grave significance.

FORMATION OF SPECIFIC AGGLUTININS AND OPSONINS IN THE BLOOD SERUM OF PERSONS SUFFERING FROM PNEUMOCOCCAL INFECTIONS.

Lister (1913) has pointed out that the serums of patients recovering from lobar pneumonia usually acquire opsonins and agglutinins for the particular strain of pneumococcus responsible for the infection, and that "virulent" pneumococci, i.e., pneumococci which have been directly derived from a hepatized lung, are readily phagocyted and agglutinated by such sera. These antibodies are not found in the early stages of the infection, but appear at or about the time of the crisis, and continue in the blood for some time after this period.

The blood sera from the pre-critical stage of 18 cases of lobar pneumonia, 2 from early broncho-pneumonia, 5 from pneumococcal meningitis, 1 from bronchitis, 1 from a pneumococcal septicæmia, and 2 from cold in the nose—29 in all—have been tested against type strains or strains obtained from the cases. In no instance was any evidence of agglutination or phagocytosis of the pneumococci noted.

Similarly forty-one sera taken after the crisis in cases of lobar pneumonia, or at a late stage of other infections, have been examined for the presence of opsonins and agglutinins. The following results have been obtained :—

Nature of infection				Positive	Negative
Lobar pneumonia	..	..	..	24	.. 1 (subsequently died)
Broncho-pneumonia	..	..	..	6	.. 3
Chronic empyema	..	..	..	2	.. 0
Bronchitis	..	..	..	0	.. 3
Septicæmia (pneumococcal)	..	..	..	0	.. 1 (subsequently died)
Cold in head	..	..	..	0	.. 1

These findings are in agreement with those of Lister as regards the lobar pneumonia cases, but cases of broncho-pneumonia and chronic empyema also appear to produce antibodies in the serum. These antibodies may be used to determine the type of pneumococcus which has caused the infection, and may serve as a useful guide to vaccine therapy. In the following tables, I, II, III and IV, are noted the cases from which these observations have been made.

SEROLOGICAL REACTIONS OF SEVENTY-SEVEN STRAINS OF PNEUMOCOCCI ISOLATED FROM VARIOUS SOURCES.

In the following tables are set out the chief particulars of the pneumococci isolated during this work in their serological groups. Where agglutinins and opsonins were developed in the blood serum of the cases examined, strains of cocci derived from two separate sources where possible—such as blood culture and empyema pus—were tested with this serum and with standard antipneumococcal serum. Thus in Table I, Number 43, strains of cocci, obtained from the sputum and from empyema pus, agglutinated with antipneumococcal serum type I, and with the post-critical serum of the case, phagocytosis of the cocci being present. In Case 71, Table I, a case of meningitis, death took place, the blood serum contained no agglutinins, both strains isolated from the cerebrospinal fluid and from the blood culture agglutinated with type I antiserum. In no case have two “standard” strain pneumococci (and by this I understand types I, II and III) been isolated from any single patient, nor have agglutinins or opsonins for more than one strain of pneumococci been found in the post-critical serum of any case.

Pneumococcus C Lister, or Type I Rockefeller.

In Table I are set out the C Lister or type I group of pneumococci. This group contains 31 members, of which 26 were obtained from cases of lobar or broncho-pneumonia, and it is noted that 11 of these cases were complicated by empyema formation. Of these 31 cases 8 died, 4 of pneumonia, 1 complicated by a terminal meningitis (No. 173, a chronic empyema of seven years' standing, who was in a state of advanced waxy

disease on his admission to hospital for operative treatment), 1 of meningitis, and 1 of septicæmia, No. 182.

TABLE I.—PNEUMOCOCCUS C LISTER OR TYPE I ROCKEFELLER.

No.	Disease	Age	Day of disease	Source from which pneumococcus was isolated	Agglutinins in serum		Hæmolysis	Lysis in bile salts	Result
					A.C.	P.C.			
124	Lobar pneumonia..	20	5	Sputum	—	+	—	+	R.
113	" " ..	19	4	Blood culture ..	—	+	—	+	R.
70	" " ..	40	P.M.	Heart blood ..	..	..	—	+	D.
43	Lobar pneumonia, empyema	24	12	Sputum, empyema pus	..	+	—	+	R.
167	" " ..	31	35	" " ..	..	+	—	+	R.
166	" " ..	24	35	" " ..	..	+	—	+	R.
157	Lobar pneumonia ..	25	5	Sputum	—	..	—	+	D.
141	Lobar pneumonia, empyema	6	14	Empyema pus ..	..	+	—	+	R.
125	" " ..	?	21	" " ..	..	+	—	+	R.
111	" " ..	5½	4	Blood culture, empyema pus	—	+	—	+	R.
95	" " ..	46	10	Sputum, empyema pus	..	+	—	+	R.
69	" " ..	7	14	Empyema pus ..	..	..	—	+	R.
173	Lobar pneumonia, meningitis	28	7	Blood culture ..	—	..	—	+	D.
169	Lobar pneumonia ..	24	6	" " sputum ..	..	+	—	+	R.
81	" " ..	14	4	" " " " ..	—	..	—	+	D.
103	Lobar pneumonia, empyema	28	11	Empyema pus ..	..	+	—	+	R.
178	" " ..	8	12	" " ..	..	+	—	+	R.
134	Broncho-pneumonia	42	5	Sputum	—	+	—	+	R.
164	" " ..	Adult	8	" " ..	—	—	—	+	R.
105	Bronchitis	"	5 yrs.	" " ..	—	—	—	+	N.
102	" " ..	"	?	" " ..	..	..	—	±	N.
152	Broncho-pneumonia, empyema	21	35	Empyema pus ..	..	+	—	+	R.
64	Asthma	Adult	?	Sputum .. ..	..	+	—	+	N.
128	Old empyema, waxy disease	48	7 yrs.	Sputum, empyema pus	+	..	—	+	D.
71	Meningitis	5	4 dys.	Blood culture, cerebrospinal fluid	—	..	—	+	D.
180	Peritonitis	41	2	Pus .. ..	..	—	—	+	D.
132	Lymphatic leukæmia, septicæmia	52	4	Blood culture ..	—	—	—	+	D.
139	Cold	35	2	Throat swab ..	—	—	+	+	R.
61	" " ..	24	3	" " ..	..	..	—	+	R.
132	Corneal membrane	1½	3	Eye .. ..	..	..	+	±	Blind
72	Mouse P.M. ..	..	2	Heart blood ..	..	..	—	±	D.

A.C. = Pre critical serum. P.C. = Post-critical serum, or serum taken late in the disease.

— = Negative result. + = Positive result. ± = Indefinite result.

R. = Recovery. D. = Died. N. = Unknown.

Case No. 182 is of interest as chronic lymphatic leukæmia had been present for some two years prior to the terminal infection. This patient was infected with what appeared to be an influenzal cold, but his condition became serious. There were fleeting signs of pneumonic consolidation in the lungs, but no definite areas could be located. Positive blood cultures, in which enormous numbers of pneumococci were found after twelve hours'

incubation, were obtained on four separate occasions during the fourteen days of acute illness. Thus in this case a pneumococcal septicæmia persisted for fourteen days. Five days before death melæna was present, and the last culture, taken two days before death, contained not only the pneumococcus in large numbers, but also streptococci and the paratyphoid C bacillus. At no period of the septicæmia were agglutinins or opsonins found in the blood serum. Unfortunately no post-mortem examination could be made.

Case No. 132 was that of a child of 5 months, who was seen suffering from a membranous condition of both conjunctivæ. A type I pneumococcus was isolated, referred to above; the child became blind.

Case No. 72 is added to the list. A mouse was found in a moribund condition in the animal house, and post mortem a type I pneumococcus was isolated from the heart blood.

Of the 31 cases of C, or type I infection it is noted that 26 were isolated from cases of severe illness and that 5 were obtained from mild infection, 2 of common cold, 2 of bronchitis and 1 of asthma.

Pneumococcus B Lister or Type II Rockefeller.

In Table II are set out the particulars of the eleven cases forming this group. Eight of these cases are lobar pneumonia, 1 broncho-pneumonia, 1 pleurisy, and 1 asthma. Two cases, both of lobar pneumonia died. None of these cases developed an empyema.

The only cases of familial infection by the pneumococcus which have been encountered in the course of these investigations occurred in this group.

Three cases (Nos. 73, 74 and 78, Table II), were all living in the same house, and all were admitted to hospital within seven days suffering from acute lobar pneumonia.

No. 73, the father, aged 47, was admitted on the second day of illness. The left base was consolidated and later the whole left lung became involved. Blood culture made upon the third day of the illness contained type II pneumococcus in large numbers. Crisis occurred on the eighth day but the post-critical serum contained no agglutinins or opsonins. Death took place on the ninth day from cardiac failure. At the post mortem the left lung was in a state of grey hepatization. The right lung was very congested and in parts almost solid.

No. 74, son of No. 73, aged 17, was admitted on the first day of illness suffering from hæmoptosis and pain in the left chest. Consolidation of the left base was present. The temperature fell by lysis on the seventh, eighth and ninth days. Convalescence was normal. Blood culture made on the second day contained numerous pneumococci type II, and a type II pneumococcus was isolated from the sputum. The post-critical serum contained both opsonins and agglutinins for type II pneumococcus.

No. 78, a son of No. 73, was admitted to hospital on the first

day of illness. The right base was consolidated, the left base congested. The temperature fell by crisis on the seventh day, and convalescence was normal. This patient was not investigated until the eleventh day when the temperature was normal. From the sputum a type II pneumococcus was isolated, and his post-critical serum contained agglutinins and opsonins for the type II pneumococcus.

These three cases serve to illustrate the occasional occurrence of a small epidemic of lobar pneumonia.

Case No. 119, Table II, presented the clinical signs of pleurisy and although rusty sputum was expectorated in considerable quantity no consolidation of the lung was located. A type II pneumococcus was isolated from the sputum.

A type II pneumococcus was isolated from one case of mild infection No. 107, the remaining ten cases were severely ill.

Pneumococcus A Lister, Type IV Rockefeller.

In Table IIa are set out the five strains of Lister's A pneumococcus, which have been isolated during this work. As noted above Lister (1917) states that thirty-one per cent of the pneumococci isolated by him have belonged to this group, 21·6 per cent to the C group or type I Rockefeller and 16·2 per cent to his B group, Rockefeller type II. Strains of this type A pneumococcus were sent to the Rockefeller Institute, examined by Dochez and Gillespie (1913 Lister) and placed in type IV. This strain has apparently not been found in America.

In examination of the serological characteristics of these type A pneumococci by the opsonic technique with fifteen minutes incubation, no agglutination or phagocytosis of the cocci occurred, but when the incubation time was increased to one hour some small but definite degree of reaction was noted and these A pneumococci have been placed in this communication as a sub-group of type II for this reason.

Two cases of lobar pneumonia, both of which were complicated by empyema, and two cases of broncho-pneumonia, were infected by this A pneumococcus, and in all four cases agglutinins and opsonins were present in the blood serum. In the fifth case, No. 118, Table IIa, a malignant growth of the lung was present; an empyema developed, from which this A pneumococcus was isolated. This case died, but no antibodies were found in the blood serum.

This type A pneumococcus so frequently observed in the natives of South Africa, is therefore present as a pathological organism in this country, though it has not yet been definitely identified by workers in America. Of the five cases due to this type of infection, three died, the causes of death being lobar pneumonia, broncho pneumonia, and empyema complicating malignant disease of the lung. As far as one can judge from this small series of cases the presence of the type A pneumococcus is associated with a severe type of infection.

TABLE II.—PNEUMOCOCCUS B LISTER, OR TYPE II ROCKEFELLER.

No.	Disease	Age	Day of disease	Source from which pneumococcus was isolated	Agglutinins in serum		Hæmo-lysis	Lysis in bile salt	Re-sult
					A.C.	P.C.			
80	Lobar pneumonia ..	20	2	Blood culture, spu- tum	—	+	—	+	R.
74	" " ..	17	1	Blood culture, spu- tum	—	+	—	+	R.
78	" " ..	24	11	Sputum .. ..	..	+	—	+	R.
73	" " ..	47	3	Blood culture, spu- tum	—	—	—	+	D.
165	" " ..	29	4	Sputum	—	+	—	+	R.
149	" " ..	18	6	Not isolated ..	..	+	..	..	R.
148	" " ..	48	2	Blood culture, spu- tum	—	..	—	+	D.
75	" " ..	18	5	Blood culture, spu- tum	—	+	—	+	R.
145	Broncho-pneumonia	19	13	Sputum .. ..	..	+	—	+	R.
119	Pleurisy	38	3	" " .. ..	..	..	—	±	R.
107	Asthma	34	4	" " .. ..	..	..	+	+	R.

A.C. = Pre-critical serum. P.C. = Post-critical serum, or serum taken later in the disease.
 — = Negative result. + = Positive result. ± = Partial reaction.
 R. = Recovered. D. = Died. N. = Unknown.

TABLE IIA.—PNEUMOCOCCUS A LISTER, OR IV ROCKEFELLER.

No.	Disease	Age	Day of disease	Source from which pneumococcus was isolated	Agglutinins in serum		Hæmo-lysis	Lysis in bile salt	Re-sult
					A.C.	P.C.			
89	Lobar pneumonia, empyema	3	12	Blood culture, pus, sputum	..	+	—	+	D.
168	Lobar pneumonia, empyema	64	35	Sputum, empyema, pus	..	+	—	+	R.
118	Empyema, growth of lung	40	48	Empyema, pus ..	..	—	—	+	D.
122	Broncho-pneumonia	46	10	Sputum .. ..	..	+	—	+	D.
104	" " ..	36	10	" " .. ..	..	+	—	+	R.

A.C. = Pre-critical serum. P.C. = Post-critical serum, or serum taken later in the disease.
 — = Negative result. + = Positive result. ± = Partial reaction.
 R. = Recovered. D. = Died. N. = Unknown.

Pneumococcus Unclassified Lister, Type IV Rockefeller.

Thirty strains of pneumococci have been isolated which do not correspond to Lister's F G J or K strains, and must therefore be placed in his unclassified list, that is the Rockefeller type IV.

From these thirty strains four have been taken and antisera (designated Harding, Hinman, Eccles, and 5073) prepared.

Pneumococci Harding, and 5073 were isolated from two cases of meningitis; Hinman and Eccles were obtained from the sputum of cases

of chronic bronchitis. With these four antisera it was possible to group fourteen of the thirty type IV pneumococci.

In Table III are set out the particulars of these sub-groups Harding, Hinman, 5073 and Eccles.

Sub-Group Harding (eight cases).—No. 84, Table III, was the standard strain of this group, and was obtained from the blood stream and cerebrospinal fluid of this case of meningitis before death. Seven further strains of this sub-group have been identified, 2 from cases of lobar pneumonia, 4 from bronchitic sputa and 1 from common cold. Two cases, the original meningitis case, and one case of lobar pneumonia died.

TABLE III.—PNEUMOCOCCUS TYPE IV ROCKEFELLER.

Sub-Group Harding.

No.	Disease	Age	Day of disease	Sources from which pneumococcus was isolated	Agglutinins in serum		Hæmolysis	Lysis in bile salt	Result
					A.C.	P.C.			
78	Lobar pneumonia ..	51	5	Blood culture, sputum	—	+	—	+	R.
175	„ „ ..	53	3	Blood culture, sputum	—	..	—	+	D.
154	Bronchitis	30	Weeks	Sputum .. ..	..	..	—	+	N.
144	Post-anæsthetic bronchitis	24	4	„ .. ..	..	..	—	+	R.
140	Influenza and bronchitis	32	10	„ .. ..	..	—	—	+	R.
138	Post-anæsthetic bronchitis	Adult	5	„ .. ..	..	..	—	+	R.
84	Meningitis	23	2	Blood culture, cerebrospinal fluid	..	..	—	+	D.
146	Cold	18	5	Throat swab ..	..	..	—	+	R.

Sub-Group Hinman.

130	Tuberculous broncho-pneumonia	26	Weeks	Sputum	—	—	—	+	N.
163	Chronic bronchitis	Adult	Years	„ .. ..	..	..	—	+	N.
174	Post-anæsthetic broncho-pneumonia and empyema	52	4 days	„	—	..	—	+	D.

Sub-Group 5073.

126	Meningitis	24	3	Cerebrospinal fluid	..	..	—	±	D.
161	Pleurisy, empyema	28	5	Empyema, pus	—	+	R.

Sub-Group Eccles.

112	Chronic bronchitis	Adult	..	Sputum	—	+	N.
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A.C. = Pre-critical serum. P.C. = Post-critical serum, or serum taken late in the disease.

— = Negative result.

+ = Positive result.

± = Partial result.

R. = Recovered.

D. = Died.

N. = Unknown.

Sub-Group Hinman (three cases).—No. 130, Table III, was the standard strain of this small group, and was isolated from the sputum of a case of tuberculous broncho-pneumonia. The sputum contained numerous

tubercle bacilli. The remaining two strains were isolated: one from the sputum of a case of chronic bronchitis, the other from a case of post-anæsthetic broncho-pneumonia who subsequently died. This case (No. 174) developed an empyema.

Sub-Group 5073 (two cases).—The standard strain, No. 126, Table III, was obtained from the cerebrospinal fluid of a boy who fell from a bicycle, fractured his skull, and developed a pneumococcal meningitis. In this case the pneumococcus failed to lyse in two per cent bile salt until sub-cultured several times. The second example of this sub-group was isolated from the pus of an empyema.

Sub-Group Eccles (one case). This organism was isolated from the sputum of a case of chronic bronchitis, and so far no further examples of this sub-group have been isolated.

TABLE IV.—PNEUMOCOCCUS TYPE IV ROCKEFELLER, UNCLASSIFIED.

No.	Disease	Age	Days of disease	Source from which pneumococcus was isolated	Agglutinins in serum		Hæmolysis	Lysis in bile salt	Result
					A.C.	P.C.			
155	Lobar pneumonia ..	34	6	Blood culture, sputum	—	+	—	+	R.
143	Lobar pneumonia, empyema	6	14	Sputum .. ..	..	+	—	+	R.
179	Lobar pneumonia ..	16	9	„ .. ..	..	+	—	+	R.
183	Lobar pneumonia, empyema	3	12	Empyema, pus ..	..	—	—	+	R.
103	Bronchitis	Adult	Years	Sputum .. ..	..	—	—	+	N.
156	„	28	3 mths.	„ .. ..	..	—	—	+	R.
114	„	Adult	Mths.	„ .. ..	..	..	—	+	N.
153	Bronchitis, asthma	27	7 days	„ .. ..	..	..	—	+	N.
123	„ post-anæsthetic	20	3	„ .. ..	..	..	—	+	R.
150	Bronchitis	38	Weeks	„ .. ..	..	..	—	+	N.
121	Broncho-pneumonia	32	14 days	„ .. ..	..	+	—	+	R.
120	Meningitis	4/12	6	Blood culture, cerebrospinal fluid	—	..	—	..	D.
171	Cold	45	5	Sputum .. ..	..	..	—	+	N.
147	„	44	Weeks	Throat Swab ..	..	..	—	+	R.
109	„	18	3 days	Sputum .. ..	..	..	—	+	N.
115	„	40	Weeks	„ .. ..	..	..	—	+	N.

A.C. = Pre-critical serum. P.C. = Post-critical serum, or serum taken later in the disease.
 — = Negative result. + = Positive result. ± = Partial reaction.
 R. = Recovered. D. = Died. N. = Unknown.

Unclassified Pneumococci. Type IV Rockefeller.

In Table IV the remaining sixteen strains of pneumococci are set out which were not grouped by any of the antipneumococcal sera used during this work.

One case, No. 120, Table IV, a child of four months was admitted to hospital with an abscess on the back of the hand which had been present

for six days. The child had a high temperature, and had developed signs of meningitis. The cerebrospinal fluid contained pus and pneumococci, and the blood culture was positive, enormous numbers of cocci being present in a twelve-hour culture. A thick blood film contained several groups of pneumococci. The child died ten days after the abscess of the hand developed but no antibodies were present in the blood serum.

This was the only death amongst the sixteen cases in this group.

Four cases of lobar pneumonia, two of which developed empyema, one of broncho-pneumonia, six of bronchitis, and four of common cold are present in this collection of unclassified pneumococci.

From a survey of these serological groups of pneumococci one finds that of the 77 cases examined 47 are members of Lister's A, B, or C groups, i.e., types I and II Rockefeller with the addition of the A group; and 30 cases belong to the heterogeneous collection type IV, none of which were found to be similar to Lister's F, G, J or K groups.

Taking the incidence of cases of serious pneumococcal infections as lobar pneumonia, broncho-pneumonia, meningitis, and septicæmia occurring in the A, B and C infections, thirty-five or seventy-four per cent fall into this category, the remaining infections being of a milder type bronchitis, cold, asthma, etc.

Lister's figures (1917), noted above, place some seventy per cent of his cases of lobar pneumonia in types A, B, C and E, and Cole (1913), also quoted above, places some seventy per cent of his pneumonia cases in types I, II and III. The figures for the three areas would appear therefore to be somewhat similar, type I and II pneumococci being frequently present in serious pneumococcal infections in this country.

On an examination of the type IV infections, 12 or 40 per cent are of a serious nature and 60 per cent more mild. Thus although over half the cases from which this type of coccus was isolated are mild, these cocci are capable of producing any of the serious forms of infection, meningitis, lobar pneumonia, and broncho-pneumonia, instances having appeared in the list of cases examined above, but do not produce these serious forms of infection in such a high percentage as the type I and II pneumococci.

CONCLUSIONS.

(1) That the pneumococcus presents its most typical appearance in fresh body exudates, and that bile solubility, and absence of hæmolytic activity are almost constant characteristics of pneumococcus.

(2) That for the separation of pneumococci in sputum and pus, Dudgeon's method is a convenient and satisfactory one.

(3) That the fermentation reactions of the pneumococcus are of no value for the division of the organisms into types.

(4) That pneumococcal antibodies corresponding to the type of pneumococcus responsible for the infection, though not present in the early stages of the disease, are usually formed in the post-critical blood serum of

cases of lobar pneumonia, and in the later stages of some other pneumococcal infections.

(5) That the pneumococci responsible for lobar pneumonia and other serious pneumococcal infections in this country are similar to those found in America and South Africa.

(6) That type IV pneumococci are capable of producing any of the serious infections due more commonly to type I and II infections.

I have to thank Sir Frederick Lister for his kindness in forwarding the standard strains of pneumococci which formed the basis of this work.

I am also greatly indebted to Professor L. S. Dudgeon for much kindly help and advice, and to the members of the staff of St. Thomas's Hospital for permission to obtain material from their cases, and for the use of their clinical notes.

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FRAGMENTS.

BY COLONEL SIR ROBERT FIRTH, K.B.E., C.B.

XXVI.

It has happened that the issue of the last census preliminary report coincides with my revision of a certain text-book and the conjunction suggests how an apparently dry and matter-of-fact subject, such as vital statistics, may be and is a matter of practical interest. To everyone, life is an asset and to many the only asset; it follows, therefore, that anything which throws light on its present value must be of importance. Our daily newspapers have made it clear that the mere enumeration of the people involves an extensive and elaborate organization costing the State a substantial sum of money, but the facts so obtained are but the bricks, stones, or rough material from which a great and complex structure has to be built up, and upon whose stability and reliability the comprehension of a number of social problems depends, as represented by the comparative health of different districts and communities or of the same districts and communities at different periods, and the calculation of premium by insurance offices or mutual benefit societies.

Most readers of this Journal have had to consider the subject and they realize that the work of the biometrician is far from simple. The use of calculating machines has reduced much of the arithmetical drudgery but, even now, to obtain the finer results the integral calculus and other processes of the higher mathematics must be employed. The results of all this labour are practically this: having obtained the basic facts as presented by the numbers of people, by sex, age, occupation and location, it is possible, by applying known death-rates to this population, to ascertain how many of each sex, at every year of life, have died. From these facts, a curve can be constructed along which the population dies off and from which is deduced in terms of years the expectation of life at each year of age for each sex. In completed form this is a life-table but actually it means many pages of figures giving the vital careers of say a million newborn babies to their death. It is applicable to the whole country or to smaller areas and large towns and usually calculated every ten years, based on the data for the whole decennium. Unfortunately the latest available is for the decennium ending in 1911 and that for London only.

Giving the facts a personal touch it is worth while looking to see what the table has to tell. The first thing I learn is that out of every 100 boys who were born with me in 1858 there are now (1921) only thirty-nine survivors and that by 1940 there will be barely eight of us alive to praise the good old times of the early eighties when I joined the

Service. Looking back over the years, I am confronted with the cold fact that, with the onward march of time, I have lost from my original contingent the greater number of my comrades. Within the very first year of our march through life fourteen of us fell out, while barely three-fourths of us ever reached the age when we could contemplate marriage. By the time that we had reached 40 years of age, our dwindling ranks had become reduced from 100 to sixty-four and thus, losing at least one contemporary every year, we survivors, aged 63, form a minority of whom one-eighth are widowers. The casualties increase with the years, so that in twenty-seven years' time there will remain two or perhaps only one veteran to boast of ninety years.

Undoubtedly, there is an element of sadness in all this, but the table has its cheery side and tells me something else. It tells me what is the present value of life at my age or at any other age. It tells me that if I were born this year I should have a reasonable chance of living 46·75 years and that, if I were a girl, my future life would probably be 51·4 years; but now, having lived 63 years, I may expect to live until the age of 73. However, there is more to come, for if I reach 73 the table assures me that I may expect to live another seven years and so reach 80. But, even then, I need not despair, for at that age I am given the expectation of living until the age of 85, at which age I may still hope to live until 88 or 89 and so on, stage by stage, until the time arrives when, as a mature gentleman of 105, I am told that there is a reasonable chance of living yet another twelve months. Truly, as Cicero said, "there is no man so old but that he expects to live another year." Whether I really am keen to reach the age of 106 or even 105 is doubtful, but I do own to wishing to live a little longer. Evidently, while there is life there is hope, and I preen myself with the thought that there is life in the old dog yet.

There is, however, another way of regarding what is called expectation of life. Every day people are arranging ninety-nine year leases of property and making agreements covering a long term of years, and yet how many men when they sign the papers ever think that their youngest born may live to see the running out of those long-term agreements? The baby of to-day may well be the hale old man of 2000 A.D. There is romance and matter for dreams in the fact. While the era through which I have lived has seen social, scientific and mechanical progress undreamt of by my grandparents, every youth of to-day realizes that the coming years will see discoveries and inventions that will make a yet newer world out of the new world of my time. We are fumbling with great problems which our children and grandchildren will solve and the citizen of the year 2000 will discuss steam power as a clumsy expedient and marvel at our limitations in exploiting flying, submarine navigation and wireless telegraphy. In that day, doubtless the power of the atom will have been harnessed and the vast stores of power latent in every clod of earth will be available, making coal-mining a forgotten industry, the petrol engine obsolete and its

place taken by engines in which released electrons will be the source of power. Many of those now living may see these things, for, even now, seven in every 1,000 live to the age of 80. And who can doubt but that in that saner, cleaner, healthier world, for which we of to-day are preparing, life will be longer than it is at present.

So much for the individualistic view, but there is also the communal or national aspect of expectation of life. Take inner London, for instance, with five millions of people; if we add together all the expectations of life of those people we get some 180 million years which is the life capital of that community. This capital is reinforced by births and squandered by deaths, especially by early deaths. Moreover, the same expression can be utilized as an index of the ravages of disease. If, in place of saying that of every 100 children, 2 die of measles, 8 of phthisis, and 9 of influenza, we say that measles accounts for the loss of half a million years, and tuberculosis and influenza each for some two million years of life capital per million children born, we get an insight as to what the prevalence of these diseases really means to the community. Admittedly, everyone has to die at some time or other, but unfortunately the larger number of deaths in the earlier years of life are from causes which are largely preventable, that is to say they die before they ought to die with a corresponding waste of life capital. It is not difficult to imagine an ideal community in which avoidable sickness and deaths were banished, but it is not easy to make it a reality.

The diminution of disease and the reduction in the number of preventable deaths, as the result of the last sixty years' efforts, affords the promise of an ideal community in years to come; even now, roughly, thirty-six out of 100 lives are spared which formerly were lost, spared not permanently but to die naturally later on with a great addition to the life capital of the community. This amelioration is still going on, but it can not go on indefinitely in respect of the death-rate for all ages, because the older people who were spared fifty years ago are now dying off naturally; however, so far as the death-rate at earlier years is concerned the reduction is proceeding rapidly. I do not know whether I shall live to see any of the next life-tables as based on the recent census returns, but they are certain to be encouraging, and to those who know how to read the figures, they, like the present one, will have doubtless both a grave and a gay side. For myself, I have elected to regard mainly the cheerful aspect of the existing life table and, should I live to see the next one, perhaps I may find encouragement to hope to see even the one after that. We never know our luck, so I refuse to look on the gloomy side of the table and continue to put reliance on the hopeful assurance at present vouchsafed to me that there may be still ten or a dozen years of life ahead, and that at the end of that time the question of granting me a still further extension of the lease on life stands a good chance of being reconsidered favourably.

Qui vivra verra.

XXVII.

For want of having something else to do, I spent a recent forenoon in one of the courts of the King's Bench. The case which I heard being tried was no *cause célèbre*, but simply one of conspiracy to defraud, in which the major point was an alleged conversation between two men. The evidence submitted in court presented features which prompt reflections on some fallacies apparently inherent in human testimony, not devoid of general interest. It will be conceded that the value of human testimony is a variable quantity, and that in everyday life our belief in direct testimony to an event is conditioned by the nature of the event or its initial credibility, and by our estimate of the personal equation of the witness. Thus, when A tells me of the particularly low score with which he has gone round the golf course at Stoke Poges and the number of miles his motor car runs on a gallon of petrol, the credibility of that particular witness is at a minimum, but when he talks to me about the value of certain stocks and the potentialities of certain companies, I take his word without hesitation. In those particular cases I know the man, and estimate the value of his statements with confidence; but when the witness, as in a law-court, is personally unknown to me, my conclusions are less confidently reached. In such a case I am influenced by the man's manner in the witness-box, which enables me to class him as a member of a certain type; also I am guided by the initial credibility or probability of the event, and by my estimate of the general value of human testimony.

As a guide in the affairs of life, probability is omnipresent, but its definition is elusive. The mathematicians have made much play with it, defining it as the ratio of the number of favourable cases to the number of possible cases with the proviso that the possible cases must all possess the same initial probability. The definition is thus couched in terms of the concept we wish to define, and, consequently, not helpful. We all have a vague idea that probability is numerical, as when we denote impossibility by zero, certainty by unity, and probability by a fraction between the two. Numerical probabilities undoubtedly exist, but it is questionable whether all probabilities are numerical. The truth is, mathematical probability is only a narrow subdivision of the general subject of probability relations which, like the relations of similarity, may be greater or less, that is, have magnitude, but need not be numerical. It follows that the common view of probability being based on statistical frequency is not tenable for all cases, and we are forced to found our judgments of probability or average initial credibility of alleged incidents wholly upon experience. But we have no notion of an average initial credibility which is of any use in practice; each case must be judged on its own merits.

As regards the general value of human testimony, even if we reached some average for its expression, we should never, in practice, apply it.

The utmost we can do is to establish a more or less constant relation between the testimony of classes of witnesses and classes of events. We have to divide witnesses into types, and for each given type estimate the value of its testimony to different classes of events. Further, we must allow for the difference it makes when the witness is taken as isolated and when he is taken as a member of a group of witnesses. In this way we may investigate man in his capacity as a truth-recording instrument, and hope to reach results which are of value in judicial procedure, in the study of history, the estimation of scientific research, and in various fields of inquiry such as spiritualism.

It is necessary to separate out these factors ; thus, the statements made by a witness may repose on sensations which he has experienced. In the case which I heard tried in court, an important point was the precise time at which a conversation occurred. A witness stated that it occurred at a certain hour because he heard a clock strike while he was in a workshop. Other witnesses testified that the noise of the workshop made it impossible to hear the clock strike, whereupon the original witness remembered that he did not hear the clock strike until he had left the workshop, and, moreover, admitted that he was somewhat deaf. Obviously, when a witness makes appeal to a sensation which it is possible to check or verify, the check should always be imposed. Although sensations may often be checked it is less easy with perceptions. Of his sensations, a witness will often single out some for attention and neglect the rest. He singles out those which interest him most with the result that the most relevant sensations are merely filtered through the medium of the witness's interest, or his interest has not been excited by the sensations most pertinent to his subsequent inquiry. It is on this fact of being able to distract the attention of audiences, that conjurers largely rely for their success.

In the matter of direct perceptions we may discriminate further. It is notorious that tactile sensations and deductions therefrom are of very little value. If a witness be blindfolded and asked to determine, by touch alone, the nature, the volume and the material of an object, it will be found that the replies are very inaccurate. Perceptions of odour or of taste are even less trustworthy, because the witness usually lacks a precise vocabulary, and perceives primarily odours and tastes as pleasant or unpleasant, and pays attention only to that aspect of them. For this reason, evidence of the kind is of small value in cases of poisoning. Perceptions derived through the senses of hearing and sight may have considerable evidential value, but in the case of hearing we need to proceed warily because, unless trained, it is astonishing how few people have any correct perception as to direction from whence a sound comes. Where the sound is articulate as in overhearing a conversation, we are in contact with other sources of error, due to illegitimate inference and association of ideas. This was particularly apparent in the case which I heard in court, when a witness supplied in all good faith words which collateral evidence made clear that

he had not heard. He had proved a theory of the purport of a conversation and subconsciously arranged the sounds he did hear to fit it. The same source of error applies to visual perceptions. Not everything is observed, and the lacunæ are filled in by a witness in what seems to him the most probable manner. Oversights in proof-reading furnish a familiar example of this kind of error. Also the appreciation of distances measured by the eye is very likely to be erroneous, the common mistake being to under-estimate large distances and over-estimate small ones. The same rule holds good for estimations of time intervals. This class of error is due rather to inexperience than to pure errors of perception. I believe much the same happens when different observers make estimates of the number of people in a crowd.

Assuming that a witness has received a certain image through his imperfect senses and with only partial attention, there is ever a danger that it may undergo deformation before it is produced in his evidence, especially if it has often been recalled to mind. Each time the image is recalled it will suggest others and the imagination getting to work adds here or obliterates there until the result is a real work of art. This is particularly liable to happen with women and witnesses of the emotional type. Unconscious reasoning, indeed, plays a very great part in nearly all cases of mal-observation; possibly nowhere more often than at a spiritualistic seance where, under the influence of the slightest emotions, the perceptions deteriorate and perfectly sane people make illegitimate inferences by unconscious reasoning. The same sequence is to be seen in the psychology of conjuring, when the spectators or witnesses are seldom disinterested; they strongly desire to witness certain events and the slightest suggestion is sufficient to produce conviction. The results are even worse when an event has been often narrated, because the witness is exposed not only to the suggestions from his own imagination but to the suggestions of other people. Many a witness of good faith has changed from the simple spectator of a drama to a prominent actor in it under the influence of frequent narration. The catastrophe comes when he has to bear formal testimony and, under stress of question and answer in a law-court, many a witness originally doubtful becomes perfectly sure or, forced to be precise where recollection is vague, ends up by either giving false precision to his answer or professing complete ignorance. When a witness is a member of a group, the foregoing defects due to the creative imagination are liable to be accentuated. The event will have been discussed and a uniform version gradually prepared. It is notorious that it is almost impossible to extract the original perceptions from the unanimous testimony of a number of witnesses who have been in consultation. A kind of collective hysteria would seem to be induced which amounts to what may be called mimetic testimony. Doubtless, many of the gross miscarriages of justice in the past based on collective denunciations were due to this form of mimicry.

The conclusion I reach is that human testimony has much less value

than is normally assigned to it and certainly much less value than it is held to possess in the minds of the average person. This may not be very novel, for mankind has had an immense experience of human testimony, but a recognition of the pitfalls in the field makes our knowledge more precise and enables us to see what kinds of testimony are most open to suspicion and, at the same time, reinforces the common-sense assumption that the value of human testimony is a matter of degree, varying from complete worthlessness to a very fair presumption that the event occurred as stated. The credibility of a witness still remains a vague quantity, but the chances are that it is something less than the value hitherto assigned to it, warranting our doubt on the accuracy of some historical records and occasionally of some pseudo-scientific researches.

XXVIII.

Someone has said that identities were inconceivable and all that was individual. As a philosophical statement this is true, but, all around us, we see Nature herself in the beauty and perfection to which she seems to have attained, presenting a picture of contentment in an infinitude of repetitions and similarities. The birds sing and build their nests, the spiders spin their webs, bees and wasps make their comb, fish migrate to their spawning grounds, the beasts of the field and the wild seek their food, and the trees produce their buds in precisely the same way to-day as they did in the days before the Heptarchy. These being the conditions of life in Nature, we must not complain if much of our human existence is passed after their pattern. Man alone is reputed to have the power of detaching himself from his surroundings and consciously proposing to himself the problem of his response to them. And yet the tragedy of his life is that he exercises it so little, and that he relapses so easily into a creature of custom, controlled in his actions by the obvious and the predictable. Surrounded on all sides by a life that merely repeats itself, sustained by and partaking of this repetition, we cannot fail to cherish the great quality which distinguishes us from the mass. It is true that we love the old more than the new, but it is the new which holds our attention; since real change is imperceptible and our need of it so great, we veil the fundamental monotony of things under the kaleidoscope of fashion, and console ourselves with changing appearances. But we need to go deeper and to recognize that change and novelty, to which the mind tends to attach primary significance, occur only at the edges of the great sea which, out of its vast depths, sends out almost invisible feelers towards the shore. Yet we are ourselves those feelers, and the problem of the intellectual life seems to lie in a reconciliation between the conscious wave-fringe and the vast unconscious sea on which it is borne.

Man is Nature's unfinished work; were he a completed being, Nature would be content to go on repeating him to the end of time, but all our

experiences indicate that she is not yet satisfied. Man is aware that he fronts the world with demands which it does not satisfy, and he recognizes that the environment in which he can at last truly live is one which he himself must create by transforming the crude materials which Nature offers him. He has only one means by which to attain his desires, and that is by developing to the full that principle of consciousness in action which is his birthright, and which warrants the sense of his distinction from the rest of Nature. For this reason we are suspicious of mere habit, regarding it as a reinvasion by the enemy of territory once won from her, and are apt to destroy what we have erected or built up, so soon as it appears to us to have fallen back into automatism. Herein lies the germ-seed of revolution and other social upheavals. The road to safety lies in well weighing our purpose or will to change against the huge volume of Nature's inertia, and taking care to be neither lured into immobility with the mass behind us, nor into the impetuous rush which would cut us off from it to disappear in the abyss. If we cease to think or lose the faculty of change, we lose the very essence of our humanity ; if, on the other hand, we allow our thoughts to run away and wander or forget the limitations of its power, the very instrument of our salvation isolates and destroys us.

From this point of view, it is interesting to consider our position in the world to-day. The eighteenth century with the advent of mechanical power and the development of factory life brought us in contact with a new world in which, while some failed to think of the new class of operatives except as material to be exploited and a danger to be suppressed, the greater number were hypnotized by a sense of pride and satisfaction at so many evidences of human perspicacity or shrewdness, and felt secure that the way was easy before us towards prosperity and peace. But our optimism was unschooled. Then came the great upheaval of 1914-18 which made it clear to the proud inventor of machinery that he was as little the master of his own fate as he had ever been. The days of the great disillusion dawned and, instead of the security in which we had been rooted and to which we were inured, we were face to face with insecurity, not only for our own country but for the world. The advent of peace has not re-established us, for we have still before our eyes examples of political and social ruin, appeals to subversive principles and methods, with the threat of action of that kind which once started can be neither guided nor checked and ends only in exhaustion. There is no need for pessimism but only for clear thinking. With the little that is left us of the world which we once knew, there is yet some comfort to be drawn from the crises of experience. We are like a convalescent after an illness which has left him crippled, but who realizes that the race is not always to the swift. It is the old tale of experience out of suffering in which the experience transcending the suffering becomes less an acquisition than an instrument of advancement.

The pessimists and the superficial cry out for a leader, but that appeal

is instinctive, rather than reflective. The day is gone in which it was possible for the mind of one man to form a mould into which generations of his fellows could be unconsciously fitted. Our conditions are now such that no disposition of life into which the majority of men were merely directed could be stable and, moreover, the unconscious reaction to such an attempt would be, in itself, a danger to the race. Our need is for a new understanding of problems which are new; liberty is abroad everywhere, not only as an idea but as a circumstance; men no longer can be safely repressed, nor is it wise to think very much of guiding them. They can only be guided by being taught to guide themselves. The revolution which machinery brought into the world was accompanied by no corresponding mental revolution but, now, owing to the wide dislocation between our consciousness and its surroundings we are aware of the force we have generated and which we have not learned to control. To be fore-warned is ever to be fore-armed, and although our danger be great it is lessened by our recognition of it. The call is for men capable of conscious participation in the whole human adventure; not in hundreds but in thousands, and there are not wanting signs that we may get them, the most encouraging being that the proletariat have so far shown the grace of an uncertainty and refrained from enthroning their virtue by their strength. It is in the nature of every class to believe itself the government and repository of worth, and to the stimulus and forcible education of passing events must we attribute the grace vouchsafed to us.

Admittedly, we live in a time of transition. Human civilization has burnt certain of its garments and emerged into a world as to which it seeks to re-orientate itself. Progress may or may not be the general order of things but, if we are to be saved, we must look for our security in the universal individual mind. The world is new, and there is only one way to meet it; we must become new men. We need to remember that we are playing for a large stake, and can but hope that the upheavals we have witnessed and witness still may produce the commodity we most need, and that is instructed minds capable of embracing unaccustomed distances and yet retaining, in the rush of things, its promptitude and its composure. This is a large demand because, though the glance of the mind may be swift, it is slow in power of fundamental assimilation and understanding. I can think of New Zealand or Australia in a second, but a six weeks' voyage separates me from them physically, and mentally the gap is not of weeks but of years; similarly, I can think quickly of China or Japan but my mind will not be in either country in less than sixty years. Although the network of mechanical relations that we have contrived makes men and nationalities appear contiguous and to act under a show of contemporaneity, in reality the distance between them is of years and generations. It is the same in respect of men and things near at home and but one item in the new burden of our fate; we are confronted with barriers the mind has never crossed or attempted to cross. If we are to

cross them, it can only be by a development of the sense of concerted responsibility.

History shows that man tends to run into blind alleys, imprison himself in them and stagnate. Developing restlessness, he finds relief in violent disruption of the confining walls; he wrecks his life for a dream and starts out a pioneer from its ruins. But men are not prisoners now; if they are, they are prisoned by their own inadequacy and by their sense of littleness before the vast horizons opening out on every side and by which the routine of their existence is rebuked. Humiliated and embarrassed by such conditions they may be tempted to reply to the challenge by childish nervous impulses of impatience and destruction. It is an acid test and the test whether our nature is inherently capable of growing to the greatness of the world we have made. The conditions of growth are there, but the problem is, will the growth be quick enough to save us? Personally, I think it will be. Nevertheless, the revolutionary spirit is abroad and we can recognize it by the prevalence of strange hopes. Providence is said to hide its smiles under a frowning exterior; whatever incites to revolution has a contrary habit, the smiles coming first and the frowns with thunder to follow. It is not apparent that we have done much to satisfy the great needs and hopes which prevail, neither is it apparent that a cataclysm is inevitable. Certainly, the signs indicate that the external revolution is in abeyance, but that is no warrant that an internal one should not be tried. Unfortunately, men cannot change their minds as they do their clothes and just turn them inside out at the expense of a mere decision; and it is the minds which reach decisions most easily which are the readiest to abandon them. The attitude of mind we require is one which involves revolution in another sense, it is an attitude to which the object is central, having the mind for its circumference, and the mind, having seen the object from every point, can then reconcile the opposing influences without prejudice. Convinced of such need and that the circumstances of our time were favourable to the attainment of a mental revolution such as this, I have been tempted to reflect upon some of the limitations and conditions set to the revolving mind. Our need is activity of thought in respect of social problems, tempered with the recognition of the fallibility of our thinking.

XXIX.

To-day, a woman sat facing me in a train with a small baby in her lap. It was a winsome little thing and as I regarded its vague features, I could not help thinking what an advantage it is to be born half-made and how therein lies the secret of man's pre-eminence. His brain is unfit for years to control action advantageously, he has an age of play in which he is formed unawares by a series of selective experiments or curious groupings, and suffers little by his mistakes. On the other hand, had all intelligence

been developed in his mother's womb, nothing essential could have been learned afterwards. Under such circumstances, mankind would have contained nothing but doctrinaires and the arts and sciences would have stood still. This is consistent with experience, because the most precocious are usually incorrigible and, while they seem the cleverest at first, prove ultimately to be the least intelligent. The inference is, that structure pre-formed is formed blindly and that the *a priori* is as dangerous in biology as in philosophy.

Intelligence is no compulsory possession, and while some of us would gladly have more of it, others find that they already have too much. The infant before me could hardly be said to have any intelligence and I began to wonder to what degree of that commodity it would attain in later life, and how much mind it had at the present time. Possibly none, because mind is a value which accrues to the body when it has reached a certain perfection. Neither could I credit the infant with serious cerebral processes; these, even in adults, are largely hypothetical. Theory suggests their existence, but experience can verify that theory only in an indirect and imperfect manner. Admittedly, the addition of a physical substratum to all thinking is only a scientific expedient, but to separate things so closely bound together as are body and mind would be an artificial divorce. But to avoid divorce we must avoid unnatural unions and, consequently, we must not attribute to body and mind relations repugnant to their respective natures and offices. With that vegetative infant before me and staring at me with vacuous eyes, it was forced on me how much the body is but an instrument and the mind its function, the witness and reward of its operation. But the limits set to observation render the mental and material spheres far from coincident though they are mutually supplementary. While the body feeds the mind, the mind perfects the body, lifting it and all its natural relations and impulses into the moral world, that is into the sphere of interests and ideas. Of interests and ideas the infant presented no evidence, clearly it had a body but its mind had yet to be.

Whence and how will that mind come? *Felix qui potuit rerum cognoscere causas*. To discern causes is to turn vision into knowledge and motion into action, whereby the calm places in life are filled with power and the heritances with resource. To begin at the beginning in the biography of mind we must fall back on uninterpreted feeling. In this manner, the child gave me the clue to the answer of the question by making a gentle movement, as though seeking its mother's breast. In that movement, on a small scale I saw illustrated and foreshadowed that life of mind and reason which is simply the unity given to all existence by a mind or function in love with the good. The discomfort of the absence of a something and the comfort of its presence enabled the infant to distinguish the mother's breast from sundry blank or disquieting presences, induced him to fix that image, mark its associates and recognize them with precision. To the image of its mother's breast was attached the chief

satisfaction that the infant knew, and the force of that satisfaction disentangled it from all other images in the feeble and fluid continuance of its life. Here was the dawn of mind and reason, for that which was first able to appease its unrest was the first to awaken in him a sense of reality. The impulse to appropriate and to reject was teaching that infant the points of the compass, and space like charity was beginning at home. In all reaches of human nature, rationality depends on distinguishing the excellent, and that distinction can be made only by an irrational impulse.

As to any causal relation between mind and body, if mental existence is to be kept standing only by a physical world, nothing could prevent humanity from becoming a mere machine. Psychic events have no links save through their organs and their objects and the function of the material world is to supply their linkage; the internal relation of ideas, on the other hand, is quite irrelevant to the march of events. If we must speak of causal relations between body and mind, I would say that matter is the pervasive cause of the distribution of mind and mind the pervasive cause of the discovery and value of matter; and when definite values of things have been estimated, with action established in harmony with that estimation, then mind and reason have been born and a moral world has arisen.

THE PHYSICAL TRAINING OF THE CHILD AT SCHOOL.

BY LIEUTENANT-COLONEL R. TATE.

Royal Army Medical Corps.

It may appear strange, at first sight, to bring forward the subject of Child Welfare for consideration in the pages of this Journal, but a little reflection will show that every medical man should have a general working knowledge, at least, of this branch of his profession, if he is to pull his weight in the effort being made to raise the physical and mental standard of each individual to a level which will enable him, or her, to take an active part in promoting the welfare of the community. Important as it may be for the civilian medical practitioner, the possession of this knowledge is essential for each of us, whose duties may be at any time in distant lands where thousands of soldiers' children are passing through one of the most important stages of their existence, far removed from the careful supervision expended on their more fortunate contemporaries at home.

Bodily fitness being essential in the make-up of an efficient citizen, systematic physical training must play an important part in the education of a child and the following notes, sketchy and marked by many defects of commission and omission though they are, have been submitted for publication in the hope that they may arouse an interest in the principles which should guide such training in children, little reference being made to details of exercises and the like.

Under the heading of physical training may be grouped all forms of exercise which are employed for the purpose of improving bodily health, and it is entirely wrong to suppose that this system of instruction is confined to courses of set movements. These have been devised solely for the purpose of presenting exercise in "tabloid" form, if one may use the term, being so arranged that all parts of the body will receive equal attention, and that the resulting development will be symmetrical.

Though the primary object of introducing physical training into school life was to counteract the evil effects on the body of confinement in school-rooms, where individuals have to remain for long periods in a state of inactivity, and in the more or less cramped positions imposed on them by the necessity for class formation, yet the results of such training are more far-reaching than they appear to be to the casual observer.

It is essential that all those to whom the supervision of children is entrusted should realize that this system of instruction must have results of an infinitely wider scope than that evidenced by increased muscular activity and physical development.

They should understand also that ill-advised exercises, by causing

mental strain and fatigue, may do much to retard a child's progress in its studies.

Further, as the finest system of physical training is of little value unless assisted by good hygienic surroundings, wholesome and sufficient food and cleanliness, it is most important that the closest attention to these matters should be paid by medical officers and instructors.

Not only does a sound body assist indirectly in the production of a sound mind, but the training carried out has a well recognized direct mental effect in arousing new nerve centres to action, by stimulating co-ordination of movement and promoting habits of self-control and observation.

The objects of physical training, therefore, are twofold :—

(1) Physical, the production of an individual whose vital functions have full play as the result of well-ordered physical conditions.

(2) Mental, the stimulation of nerve centres to their full activity and the establishing of control of mind over body.

In determining the lines on which physical training should be carried out, the best guide to a successful procedure is obtained by close observation of the steps taken by Nature in building up the physical and mental development of the child.

The earliest normal muscular activities of an infant are largely reflex and are confined to massive movements designed to assist growth by stimulating circulation and digestion, and the removal of waste products from the body. It is not until the lapse of a considerable period that one finds more intricate movements, demanding the action of individual muscles, or groups of muscles, being carried out.

Increase in the intricacy of movements depends on the development and awakening to activity of nervous centres, a slow and gradual process, and it is here that physical training steps in to assist Nature.

Experience shows that, by training a child slightly in advance of its normal mental condition, it is possible to arouse new centres to action, to establish combined action between existing centres, and to render automatic many actions previously carried out as the result of conscious thought, thus causing a great economy of effort.

As too energetic measures may have serious evil effects on the mental and physical condition of the pupil, great patience and attention are demanded of the medical officer when deciding on a series of exercises to ensure that those adopted are not too far in advance of the dictates of nature.

Danger signals are clear and decisive. Points which should be watched for are lassitude, gradually increasing irritability, and inability to carry out orders previously obeyed with alacrity, greater than that shown by other children of similar age and development, indicating mental exhaustion which may be caused by exercises which are too advanced for the pupil. Increasing pallor, breathlessness and faulty slack positions when standing easy are signs also, the significance of which cannot be neglected.

In the early stages of physical training, and in young children, it is found that "general activity" exercises, such as running, jumping, dancing and simple games are all that can be tolerated, and nothing more should be attempted until there has been an opportunity for observing their effects. As the pupil advances these exercises are gradually left behind, and movements designed to exercise definite groups of muscles, and individual muscles are substituted in steadily increasing degrees of complexity and difficulty.

Having decided the limit to which physical training may be pushed with safety, it remains to group movements in such a manner that the body will be developed symmetrically as a whole and that no one portion will receive attention at the expense of the rest, in other words to carry out exercises in "order of movement."

Certain other factors have to be considered also.

The bodily functions of a child who has been sitting in class for some hours are not in a state of full activity, respiration has not been working to its normal extent, and so the gaseous changes in the lung have not been efficiently carried out; circulation, also, is slow and the action of the heart has not been assisted by muscular activity in promoting the return of the venous blood. For both of these reasons, waste matter has accumulated to a certain extent in the tissues exerting a toxic influence on the nerve endings in the muscle.

In order to remove these harmful substances and thereby get the muscles into a condition in which they will obtain the greatest benefit from physical training, certain "introductory exercises" have been devised. These are: (a) breathing exercises, and (b) general activity exercises.

Breathing exercises may be of two types, "normal breathing" and "deep breathing," and either of these types may be carried out with or without movements of the arms designed to assist inspiration and expiration by bringing into play the accessory muscles of respiration. As a rule, it will be found that "normal breathing" exercises, with appropriate arm action, will suffice as an "introductory exercise" in normal children; "deep breathing" being reserved for those who suffer from malformed chests and feeble expansion of the lungs.

Certain precautions have to be observed when children are performing breathing exercises. The position must be erect but free, the mouth must be closed, there must be no constriction of the chest walls by clothing, expiration must be as complete as inspiration, and there must be no "forcing" of respiration. A regular normal rhythm must be maintained also, and breathing exercises must never be carried out when children are in a state of breathlessness after exertion.

Two tests, by which the thoroughness of the execution of these movements can be estimated may be mentioned: Standing behind the pupil, by placing the tips of the thumbs over the spine and spreading the fingers over each side of the chest wall, the amplitude of movement of the latter

may be readily ascertained. Again, if the pupils are instructed to whistle during expiration, one can tell when the lungs have been satisfactorily emptied of air by the cessation of the sound.

General activity exercises such as running, jumping, and dancing may be used as introductory exercises, but it is necessary to realize that they fulfil a different purpose here to that described when they were mentioned as being applicable to young children. Here they are used only as a means to an end, that of preparing the pupil for further exercises; then they were referred to as being the end itself, in that the young brain could not furnish the activating impulses for more complicated movements.

At the end of a lesson it is well to give pupils two or three minutes of "normal breathing" exercise to ease the strain on the nerves, quiet the circulation, and induce steady rhythmic respiration before the return to studies. It is interesting to note that a very similar procedure is often adopted on rifle ranges during musketry instruction, particularly when firing after a rapid advance has been carried out. One often hears an instructor say to a man "Three long breaths and then loose 'off'," a remark which goes far to prove the sedative effect of quiet deep breathing.

With increasing age and growing adroitness in carrying out the movements prescribed in the earlier lessons, the necessity arises for adding to the difficulty and complexity of the exercises, and here the skill of the instructor and supervising medical officer plays a large part in the success of the training. Too much advance may result in failure, whilst too little means waste of valuable time. It must be borne in mind always that any advance must affect the whole body equally and hence we find the term adopted "progression in order of movement," in other words each exercise in the order of movement is so advanced that its effect on the part of the body which it is designed to develop is on an equality with those arranged for other portions of the body.

In the performance of all exercises attention to detail, concentration and finish are essential to success, and no half-hearted slovenly methods of execution should be tolerated. It is important that failure to carry out movements, resulting from fatigue, should not be confounded with carelessness, as a hard working pupil who, perhaps has outstripped children of his own age by zeal and energy, may find himself in a class performing exercises which demand a greater strain than that which his development can support. Such a case should be dealt with by reduction of strain, and not by censure.

For a movement to have its most beneficial effect, it is essential that the "starting position" from which it originates should be correct. Though the position of "attention" is the starting position of all exercises, it is obvious that other positions must assume the same rôle at the commencement of each stage of a complicated movement, therefore it is clear that each exercise must be watched most carefully to ensure its successful performance.

So far the physical side of the training alone has been considered. The mental aspects need to be thought of also, and in this respect it has been found that games, judiciously selected, may play a very useful part as they are the natural outlet for energy in children, and their execution does not demand any severe mental strain. Also, by carefully interspersing them among set exercises, they add interest to a class and frequently induce a lazy child to take part in what otherwise would bore him thoroughly.

The effects of physical training on the mind are shown in many ways:—

The power of observation is increased, as evidenced by closer imitation of the movements of the instructor when movements are explained.

Will power increases, the child who has given up trying to master a new movement seems to acquire a dogged determination to succeed.

Co-ordination improves, complex movements hitherto tried without success are carried out with gradually increasing ease and without fatigue.

A shortening of the time required to translate an external stimulus, visual or oral, into action as indicated by immediate and accurate response to the instructions or demonstrations of the instructor.

Memory becomes more retentive, the details of a new movement are remembered after they have been given out on only one or two occasions to a child to whom no impressions appeared to have been conveyed by repeated demonstrations, and descriptions of simpler exercises at an earlier stage in his career.

Concentration increases and the wandering attention of a child will be found to give place to interest and a desire to understand.

As to the games most suited for the purposes of physical training, one has only to consider those of one's own childhood to find a lesson in each. Throwing and catching a ball, cricket, and football all teach automatic action and co-ordination of movement. Such a simple game as "Two's and Three's" teaches a child to keep his eyes about him, and so on—the examples being too numerous to quote.

Dancing is of the greatest value, teaching, as it does, the value of an erect free carriage, and by giving exercise to every portion of the body by gentle, rhythmical movements.

The clothing to be worn during physical training should be loose, giving free play to the limbs and trunk without impeding movements by the voluminous nature of the garments. There should be no constricting bands such as belts, collars, and braces. Boys should wear jerseys or shirts, shorts and stockings; girls being clad in smocks and short skirts and stockings. A belt worn round the waist should only be sufficiently tight to keep the garments in position.

Shoes should be worn always, as they give the foot more freedom of movement, and also boots carry into the schoolroom or gymnasium, used for drill, the dust from the outside world, which cannot but have an irritating effect on the lungs when drawn into their cavities by the increased respiration of pupils undergoing instruction.

Physical training should be carried out in the open air, unless climatic conditions prevent this course, and, in this respect, it must be understood that mere cold is no obstruction, as exercise soon warms up both the instructor and his pupils. In wet and stormy weather a gymnasium or large classroom may be utilized, the great necessities for success being plenty of space for exercises, plenty of fresh air from open windows, and freedom from dust.

In addition to the benefits which physical training confers on the pupils through its direct effects on mind and body, this system of instruction is of great value in affording to the medical officers ample opportunities of observing pupils.

Standing well apart from his neighbours in drill formation a child may be examined from all angles; his whole demeanour is under scrutiny, and any physical defects show themselves in a marked degree.

Failure to respond to instruction may be caused by either mental or physical abnormality, and both of these aspects of a child's nature should ever be under consideration.

The medical officer must keep the eternal question "Why?" always before his eyes if he is to be successful when supervising training. Does this child fail owing to feeble mental power inherited from his forebears, or is his stupidity due to adenoids? Can that child hear the instructions given to him, or is his sight so poor that he cannot follow the demonstrations of the instructor? Why does this little girl upset the whole discipline of the class by her tricks? Is she simply naughty, or is she one of the mentally defective ill-balanced type, the breath of whose nostrils is cunning and rebellion?

These few examples of a medical officer's problems may serve to show that he must possess inestimable gifts—tact, sympathy, and infinite patience, without which no one can hope to win the confidence of a child.

No mention has been made in these all too sketchy remarks of physical exercises for the correction of physical defects, as these are matters which can be dealt with only by the expert; the great function of the school medical officer in this respect is to detect the fault so that it may be brought to the notice of those whose special training renders them competent to select the measures most likely to effect a cure.

A word of warning may be sounded on the subject of exercises with apparatus before bringing these notes to a close. Free exercises, i.e., exercises without apparatus, will be found to deal with all the requirements of school life, and unless well-trained and cautious instructors are available, exercises with apparatus are better left alone. Irreparable damage may be done to children by ill-advised exercises of this nature, as the strain thrown on their muscular structures may be much in excess of that which they have been designed to bear.

THE HEART—IN EXAMINING RECRUITS AND SOLDIERS FOR DISCHARGE.

By K. R. SMITH, M.D.LOND.

DURING the war soldiers suffering from symptoms usually attributed to heart disease were sent to a special hospital. The plan adopted there for dealing with them is detailed in a Report upon Soldiers returned as cases of "disordered action of the heart" (D.A.H.) or "valvular disease of the heart" (V.D.H.). Special Report Series, No. 8.

The cases were examined and those suffering from certain well-defined diseases were at once rejected and classed for discharge. The remainder were submitted to a course of graduated exercises which served, not only as a means of sorting them, but of treating them also.

The exercises adopted were selected from the army exercises, and were so arranged that, beginning with lighter ones of short duration, they were gradually increased both in severity and duration. The exercises were taken daily and in favourable instances a patient was moved to a higher grade after three or four days. In this way he passed through seven groups of exercises in a scale of ascending severity, and eventually the highest grade was taken in combination with route marches of four or more miles, without pack, with light pack, and in full marching order.

Men who progressed to the highest exercises and carried them out without distress for several weeks in conjunction with route marches were passed as fit for full duty. Those who progressed more slowly, and those who took the highest grade exercises less perfectly were passed for light duty. Those who showed symptoms on low grade exercises were discharged as permanently unfit.

The average stay in the hospital is given as one and a half months and this period was sufficient for sorting and treating them.

This six weeks physiological test is necessarily not available for the examination of recruits and of soldiers for discharge and pension, but the Report above mentioned gives details of certain signs which have been observed and fully tested, and which have proved reliable criteria by means of which a man's condition may be estimated in a very short time. The method is easy of application.

THE EFFORT SYNDROME.

Most of the soldiers returned as cases of "disordered action of the heart" (D.A.H.) or "valvular disease of the heart" (V.D.H.) suffer from *distress upon exertion*. The group of symptoms observed in these cases has been named the *effort syndrome*, because these symptoms are provoked or intensified by exertion.

"The effort syndrome comprises the following symptoms stated in the order of their importance :—

"*Breathlessness*.—This is a constant symptom and is provoked in an exaggerated degree by exercise or emotion. Occasionally it is experienced at rest, rarely in paroxysmal attacks.

"*Pain* is an inconstant but frequent symptom and one which, when present, varies in degree from precordial discomfort to pain of anginal distribution ; it is especially associated with exercise.

"*Exhaustion* is an almost constant symptom, it is usually provoked by sustained effort, but in a degree far in excess of that due to fatigue in healthy men. In severe cases it is a continuous symptom, and is not only physical but equally mental.

"*Giddiness and Fainting*.—Giddiness is almost constant and is associated with change of posture and with effort. Attacks of fainting are less common and their associations are less easily defined. Fainting attacks owe their chief importance to their incapacitating effects.

"There remains a variety of symptoms of less consequence :—

"*Palpitation*, which is frequent, especially during or after effort.

"*Headache*, which is almost constant, frontal or throbbing in type, often severe, and usually an after-symptom of exercise.

"*Lassitude* is often present at rest. Coldness of the hands and feet, sweating of the hands and feet, or excessive sweating of the body generally are very common.

"*Irritability of temper, sleeplessness, inability to fix the attention, shakiness, flushing* are common, especially the three last named. A disinclination to take alcohol in any form (sometimes for conscientious reasons, but as commonly for reasons of distaste) is to be reckoned a frequent and remarkable association.

"The signs found on examination are equally distinctive. They are :—

"*Increased Heart-rate*.—It is the custom to find relatively rapid heart action in all circumstances, but the chief difference between patients and healthy subjects in this respect is an exaggerated response of the heart-rate to emotion, exercise and posture.

"*Systolic Blood Pressure*.—There is an exaggerated response of the systolic blood pressure to emotion and effort, and in patients who are up and about high readings are often obtained.

"*Diffusion of Apex Beat* to several rib spaces, and forcible or jerky impulse, is frequent, as is also accentuation of the heart sounds.

"*Irregularity of the Heart's Action*.—Intermittance of the heart or an irregularity which clearly accompanies respiration when this is deepened by request is not uncommon.

"*Temperature*.—Though the temperature charts are for the most part normal, small elevations to 99.5° or 100° F., fleeting in duration, are frequent.

"*Exaggerated Rate of Respiration* is the rule after exercise and may also show in the resting state.

"Coldness, blueness or wetness of the palms or soles is frequent. Sweat often trickles from the axillæ while the patient stands stripped. Tremor of the hands is the rule. *Deep reflexes* are generally exaggerated.

"The urine is hyperacid, usually deposits phosphates on cooling, calcium oxalate crystals are very common, so also are spermatozoa. Urea is reduced. Many of the urines give a green reduction with Fehling's solution. The *capillary leucocyte* count is increased, especially in patients who are up and about or exercising. The increase is more in lymphocytes than in polynuclear cells."

Of these *signs* the most useful in examination are: (1) Excessive increase in the rate of respiration after exercise, with slow return to pre-exercise rate.

(2) Excessive increase in pulse rate after exercise with slow return to pre-exercise rate.

(3) Actual signs of distress, working of the *alæ nasi* and of the accessory muscles of respiration, and an anxious expression after exertion.

And of the symptoms the most useful are complaints of: (1) dyspnœa; (2) pain; (3) exhaustion; and (4) giddiness.

EXERCISE TEST.

"Examination of the body, at rest, affords no opportunity for estimating the reserve force of the heart" (Sir J. Mackenzie, p. 46).

An exercise test is necessary for demonstrating the presence or absence of the effort syndrome. The movements of skipping serve well for this purpose: that is swinging the arms in a circular motion and jumping at the same time. Twelve to twenty skips are sufficient. Lifting dumbbells from the ground and raising them above the head (say through six feet) is another exercise test easily performed in a room. Or stooping by bending the knees and hip-joints and then assuming the erect position, thus lifting the body weight a number of times, forms a good exercise test. Another test easily applied in a room, is to step on to, and off from a chair or form, and to count the number of times this can be repeated without obvious shortness of breath. It is lifting the body weight in the same manner as ascending a flight of stairs, but the height of the chair is greater than that of a single stair and more effort is required. Repetition from six to twelve times is generally sufficient. Immediately the exercise is completed the man lies down. Any movements of the *alæ nasi* or the accessory muscles of respiration are noted: the pulse and respiration rates are counted (preferably with the stethoscope) and when two minutes have elapsed these are again counted: viz., the respiratory-rate and heart-rate.

THE EXAMINATION.

The examination falls naturally into three stages:—

In the first stage examine by the usual methods of inspection—palpation, percussion and auscultation—for: *cardiac enlargement, mitral stenosis,*

aortic incompetence, and the disorderly action of *auricular fibrillation*. Those in whom any one of these is present belong to Grade 4, or at best to Grade 3 (sedentary).

Before passing to Stage II eliminate cases of exophthalmic goitre, pulmonary tuberculosis and aortic aneurysm.

Stage II.—By means of an exercise test examine the man's capacity for active exertion.

If a man can take severe exercise over a considerable period without showing signs of the effort syndrome, it is positive evidence that the heart is sound. "*For it may be taken as an axiom that no soldier who is free from symptoms on duty has an affection of the heart which incapacitates him.*" Hence, if after a sufficient exercise test, there is no evidence of the effort syndrome he belongs to Grade I as far as the heart is concerned.

If however upon applying the exercise test, evidences of the effort syndrome are present, it does not follow that he has any disease of the heart, but it is a sign of *incapacity*, and the extent of the incapacity is estimated by the following *six criteria*, "which may be used whenever it is necessary to deal with soldiers at a single or a few examinations, provided that the symptoms are of not less than a few weeks duration." Reject as unfit for duty in any but the sedentary class:—

"(1) Those in whom the onset of symptoms dates from rheumatic fever, or in whom there has been recurrent rheumatic fever.

"(2) Those in whom breathlessness on exertion has been *tested objectively* and is found to be persistently severe.

"(3) Those in whom precordial pain repeatedly prevents exercise, the *patients manifesting hyperalgesia of the cardiac skin areas*.

"(4) Those in whom the heart-rate is persistently high (120 and over) even in recumbency.

"(5) Those in whom a single exercise test, i.e., walking up a flight of thirty steps, produces objective signs of distress, namely an anxious expression, a respiratory rate of thirty-five or over which persists while the patient lies down and is from time to time interrogated, or a pulse which fails to fall within five beats of the pre-exercise level on lying down for two minutes.

"(6) In addition it may be said that in those in whom the symptoms are of moderate severity, *but of many years duration*, only a very small percentage become fit for full duty categories. This class includes a number of soldiers who gave up games at school or who left heavy work in civil life on account of symptoms."

The application of 2, 4 and 5 of these criteria is associated with the exercise test and properly belongs to stage II of the examination.

For stage III are left (1) inquiries as to rheumatic fever; (2) the duration of the symptoms (No. 6 of the criteria), and (3) the presence of pain and hyperalgesia (No. 3 of the criteria).

In the absence of any of the conditions specified in these six criteria

but with the effort syndrome present, the man belongs to Grade II or Grade III in accordance with the severity of the signs. Only men in Grade I are fit for recruits. The course of the examination may be thus tabulated:—

Stage I.	Examine for cardiac enlargement, mitral stenosis ..	Grade IV or III
	" " aortic incompetence, auricular fibrillation ..	" IV
	and eliminate exophthalmic goitre, pulmonary tuberculosis and aortic aneurysm	
Stage II.	Effort syndrome absent	" I
	" " very severe	" IV
	" " severe and persistent	" IV or III
	" " with tachycardia	" IV or III
Stage III.	" " dating from rheumatic fever	" IV or III
	" " with history of recurrent rheumatic fever	
	" " with pain and hyperalgesia	" IV
	" " of many years' duration	" IV or III
	" " not severe	" III
	" " slight	" II

"The presence of a sign revealed by physical examination, no matter how abnormal it may seem, is of no serious significance *so long as it is the only sign present* or so long as there is no limitation of the 'reserve force' of the heart."¹

SYSTOLIC MURMURS.

It will be noted that systolic murmurs are entirely neglected in the above examination. The following reasons for so doing are given in the Report:—

"(a) Systolic murmurs at base or apex indicate valvular disease only exceptionally: there is no conformity of opinion as to the character or conduction of systolic murmurs indicating valvular lesion.

"(b) The extent of mitral valve damage which produces a systolic murmur alone is relatively slight: the disease is often limited to the valve, the heart muscle which is the essential part of the organ being wholly undamaged.

"(c) Patients who are invalided on account of systolic murmurs *alone*, are subsequently found *when tested* to be fit for active service in nearly all instances. A large number of men who present such murmurs are known to have passed the most severe ordeals of active service without accident.

"(d) If a group of patients who present no murmurs and a similar group in whom systolic murmurs exist are tested in respect of their capacity for work or active service, no difference is to be found in the capacity of the two groups."

It will be further noted that in the first stage of the examination the grading is dependent upon the diagnosis of diseased conditions.

In the later stages the grading depends upon the observed presence or absence of a *disability* without an exact diagnosis. The object of the

¹Sir J. Mackenzie, "Principles of Diagnosis and Treatment in Heart Affections," p. 43.

examination is to discover any disability which may be present, and to estimate its extent. Diagnosis is only a means of attaining this result, and when the diagnosis is uncertain, it is superseded by a direct test of disability.

Some members of the medical boards still adhere to the practice of regarding every murmur (except those in the pulmonary area) as conclusive evidence of disease of the valves and diagnose aortic stenosis and mitral incompetence whenever a systolic murmur is detected in the corresponding area, and, even in the absence of any observable disability, suggest a high rate of pension.

It is argued that absence of symptoms is due to "compensation," but that such men must have been injured by exposure to active service conditions, or even by training where there has only been home service. The frequency of such murmurs in strong active men doing strenuous work, such as those employed in farm work, cannot have escaped the notice of those who have been engaged in examining recruits; there is no doubt as to their capacity for hard work, for they do it, and there is no disability observable. They are often above the average in physical fitness and the same may be said of many of the soldiers with systolic cardiac murmurs.

Further, when so much stress is laid upon these murmurs, the presence of the effort syndrome is often not sufficiently considered and no exercise test is applied.

Amongst those coming up for discharge cases of mitral stenosis, aortic incompetence and cardiac enlargement are infrequent. Signs of auricular fibrillation, though found occasionally among those presenting themselves as recruits during the war, are apparently absent from those coming up for discharge. But cases in which systolic murmurs have been detected are very frequent. As a consequence there is a tendency for a considerable number of men with systolic murmurs and no observable disability to be assessed at a high rate of pension, while others in whom there is a severe disability, incapacitating them from sustained work of any kind, receive only a low rate of pension because no murmur is detected and they cannot therefore be classified as suffering from V.D.H.

The Report above referred to recommends that the term V.D.H. should be restricted to cases of mitral stenosis and aortic disease, and that it should not be employed on the ground that a systolic murmur is heard over the heart.

Clinical and other Notes.

SACHS-GEORGI REACTION.¹

BY LIEUTENANT-COLONEL J. L. WOOD, O.B.E., AND MAJOR D. T. M. LARGE.
Royal Army Medical Corps.

SACHS and Georgi in 1918 proposed a sedimentation test for syphilis, which consisted in making a mixture of one cubic centimetre of one in ten inactivated suspect serum, and $\frac{1}{2}$ cubic centimetre of one in six cholesterinized alcoholic bovine heart extract. This note refers to an examination of this reaction, on a series of 300 sera which were being examined in the usual course, for a Wassermann reaction. The Wassermann technique employed was that of Harrison. For supplying us with some of the sera tested we are indebted to Dr. W. R. Logan, Clinical Pathologist to the Edinburgh Royal Infirmary.

The bovine heart extract was made according to the author's description. One gramme fresh heart was extracted by five cubic centimetres alcohol ninety-six per cent, and the extract diluted as follows: 100 cubic centimetres heart extract, 200 cubic centimetres alcohol ninety-six per cent, 13 cubic centimetres of cholesterin one per cent in alcohol. The mixture was kept in the ice-chest, and diluted with normal saline at the time of use as follows: One volume of extract was rapidly added to one volume of saline, mixed and then four more volumes of saline added. The resultant emulsion was opalescent, but translucent.

The sera were heated at fifty-six degrees centigrade for half an hour, and diluted one in ten with normal saline.

One volume of emulsion (five cubic centimetres) was added to two volumes of serum one in ten (one cubic centimetre) and put into a water-bath at thirty-seven degrees centigrade, and read at varying intervals, which will be noted.

For each serum two controls were used, an alcohol control $\frac{1}{2}$ cubic centimetre of one in six alcohol in saline with one cubic centimetre diluted serum one in ten, and a saline control of $\frac{1}{2}$ cubic centimetre saline with one cubic centimetre diluted serum one in ten.

As the investigation proceeded various points were noted and led to inquiry. It may be noted here that a positive result consisted in the formation of a flocculent precipitate with greater or less clearing of the suspending fluid. There appeared to us to be considerable variations. Sometimes the flocculi were large and suspended in a nearly clear fluid. At other times they were more inclined to be granular, and deposited. An attempt at grading results taking large flocculi and clear medium as, so to speak, a \mp , with a granular precipitate and not so clear a fluid, as near the other extreme, did not help us, and for practical purposes we found a definite precipitate entailed a positive finding, unless this precipitate became no longer observable on shaking the tubes, and thereby mixing it in with the fluid.

The saline control, in no less than three per cent of cases after twenty-four hours, and in eight per cent after forty-eight hours, showed an appearance

¹ Received for publication, October 5, 1921.

indistinguishable from that of a true positive reaction. On investigating these controls, we found them usually to be infected with *Bacillus subtilis*, and sometimes with other organisms. On further investigating these points, we found that by inoculating either the saline control, or the serum-extract mixture of a known negative, we could produce this apparent positive result. This we found much easier to do in the saline control than in the serum extract tube, possibly due to the presence of alcohol in the latter, but we are satisfied that the growth of *B. subtilis* in the serum-extract tube, i.e., in the test proper, could occur, and give the requisite appearance for a positive finding.

We investigated the question of whether suspect sera in dilutions other than the one in ten described might not be better. Our results suggested that if anything, one in five gave more nearly corresponding results to the Wassermann findings than one in ten.

The duration of stay in the water-bath soon proved to be a factor of importance. From the table below, it will be seen that we got more positive results, agreeing with our Wassermann findings, at a forty-eight hours reading, than at a twenty-four, but on the other hand, we found that sera with negative Wassermann reactions, although negative by the Sachs-Georgi test at twenty-four hours, tended to become positive at the end of forty-eight hours. The number of these false positives increased still more as incubation was further prolonged. This, we consider, was due to contamination and the growth of organisms.

Wassermann reaction	Number	Shown positive by Sachs-Georgi test		Percentage of positive Wassermanns shown by Sachs-Georgi test.	
		24 hours	48 hours	24 hours	48 hours
±	68	46	55	68 per cent	80 per cent
+ ±	11	4	6	36 "	54 "
+ ∓	5	1	1	20 "	20 "
± ∓	7	1	1	14 "	14 "
± —	5	0	0	0	0
∓ ∓	2	0	0	0	0
∓ —	8	0	2*	0	*
— —	192	1	8	..	..

* This, as well as the positives shown in the sera with negative Wassermann reactions, amplifies our statement with regard to contamination.

We made further experiments on this point. We took cultures (one millimetre loopful) from every tube, test and controls alike, at the time of putting up, and after twenty-four, forty-eight, and seventy-two hours in the water-bath, we found that many of the Sachs-Georgi results that were inexplicable, i.e., where there was no corresponding positive Wassermann result, gave growths mainly of *B. subtilis*, which, of course, had every opportunity of entry to the tubes, for the test is impracticable if bacteriologically sterile precautions must be taken. The appended table shows details of this experiment on twelve of the sera. It will be seen that contaminated tubes are more frequent as incubation is prolonged, and that while a positive appearance does not by any means always follow contamination of the tube, false positives, whether in the test or in the controls, are usually associated with the growth of organisms.

	Test			Alcohol control			Saline control			Wassermann reaction
	24 hours	48 hours	72 hours	24 hours	48 hours	72 hours	24 hours	48 hours	72 hours	
	— 0	— G	— +	— 0	— 0	— 0	— 0	— 0	— G	— —
2	— 0	— 0	— G	— 0	— 0	— G	— 0	— +	— +	— —
3	— 0	— +	— +	— 0	— 0	— 0	— 0	— G	— 0	±
4	— 0	— 0	— G	— 0	— 0	— 0	— 0	— +	— +	— —
5	— G	— G	— G	— 0	— G	— +	— 0	— 0	— 0	— —
6	— +	— +	— +	— 0	— 0	— G	— 0	— G	— G	±
7	— 0	— 0	— 0	— 0	— 0	— G	— G	— +	— +	— —
8	— 0	— G	— +	— 0	— 0	— +	— 0	— 0	— G	— —
9	— 0	— 0	— G	— +	— +	— +	— G	— +	— +	— —
10	— 0	— 0	— +	— 0	— +	— +	— G	— +	— +	— —
11	— 0	— +	— +	— 0	— 0	— G	— G	— +	— +	±
12	— 0	— 0	— G	— 0	— 0	— G	— 0	— +	— +	— —

0 = negative culture; G = growth of organisms; — = negative S.G. result;
+ = positive S.G. result.

* Cannot explain this result as no growth was obtained.

The conclusions we have come to, without further detailing our experiments, are:—

(1) That in a considerable number of sera with strongly positive Wassermann reactions, there is a positive Sachs-Georgi result.

(2) Where the Wassermann reactions were less strongly positive, so fewer and fewer positive Sachs-Georgi results were obtained.

(3) That, therefore, this test is not nearly so delicate as the Wassermann reaction.

(4) By prolonging the duration of incubation beyond twenty-four hours, we got more positive results, corresponding to the Wassermann results, but as the length of incubation period increased, we got positive Sachs-Georgi results that did not correspond.

(5) Though we might imagine that sometimes we could distinguish between a positive Sachs-Georgi and the positive appearance sometimes produced by

contamination, this was really not possible, and this factor is a serious detracting from the value of the test.

(6) There is no advantage to be got by routine Sachs-Georgi tests as a control or adjuvant, to results obtained by the Wassermann test.

A SEROLOGICAL INVESTIGATION OF ORIENTAL SORE.

By W. H. MCKINSTRY, M.D., D.P.H., M.R.C.P.LOND.

Late Pathologist and Bacteriologist, Queen Alexandra Military Hospital, Millbank.

DURING the last three years a number of patients suffering from oriental sore attended Queen Alexandra Military Hospital for diagnosis and treatment.

Most of the cases had multiple sores either of the ulcerative or non-ulcerative type, and in many of the cases both types of sores co-existed.

For the reason that the sores were found on exposed parts of the body they frequently presented a more or less symmetrical distribution, which characteristic, coupled with their chronicity, often suggested the question of syphilis.

In the majority of cases of oriental sore the clinical history and the finding by the microscope of Leishman-Donovan bodies quickly decide the diagnosis. But in some cases, more particularly those of the ulcerative type where Leishman-Donovan bodies cannot be found, the question of diagnosis between syphilis and oriental sore becomes one of great importance and very great difficulty. And this difficulty may be further enhanced in some cases by a solitary sore involving such a situation as the lip or eye-lid.

Further, the diagnosis of oriental sore from syphilis has been hampered by writers on tropical diseases stating that the blood in some cases of oriental sore has been found to give a positive Wassermann reaction.

Professor Hewlitt [1], for instance, in his well known "Manual of Bacteriology" writes, "The reaction (W.R.) is not confined to syphilis. It may also be obtained (with the antigen employed for syphilis) in Leishmaniasis," etc., etc. And Stitt [2] states that "Rabello noted that a positive Wassermann may be present in cutaneous Leishmaniasis." Daniels [3] and Castellani and Chalmers [4], while recognizing the difficulty of differentiating oriental sore from syphilis, fail to mention the Wassermann test as an aid to the diagnosis. The same may be said of Manson [5]. In Daniel's work on "Tropical Medicine" we read, "Syphilis is the disease for which oriental sore is most likely to be mistaken. The absence of the other symptoms of syphilis and the failure of anti-syphilitic treatment should enable a correct diagnosis to be made." While Castellani and Chalmers write, "The only way to come to a definite diagnosis in difficult cases is the microscopical examination."

From these quotations, culled from recent and standard textbooks, it may be legitimately concluded that a great deal of doubt exists as to the value of the Wassermann reaction as a clinical test for the differential diagnosis of oriental sore from syphilis.

Influenced by these considerations I examined the blood of twenty-eight cases of oriental sore by the complement fixation test according to the Wassermann technique used at the Military Hospital, Rochester Row. In twenty-seven of the

cases the diagnosis was established by the microscopic findings of Leishmann-Donovan bodies. In one case of the series no Leishmann-Donovan bodies were found. This case presented many old cicatrices on both legs and arms, which, from their clinical history and position, were obviously the result of oriental sores.

Of the twenty-eight cases examined by the Wassermann test only one case gave a positive reaction. This case had points of clinical interest which helped to establish the fact that a positive Wassermann reaction is practically never found in oriental sore without concomitant syphilis. The case which proved the exception to the rule was one with an ulcerated oriental sore on the left cheek. Leishmann-Donovan bodies were found. The skin on the posterior side of the sore presented an irregularly raised dry scaly appearance, not unlike a chronic eczema of the beard, and prevented shaving. This condition of the skin was at first thought to be part of the ulcerated oriental sore and would most likely clear up after the intravenous injections of sodium antimonial tartrate solution, the line of treatment pursued.

In this, however, we were disappointed. The sore on the cheek healed, and the Leishman-Donovan bodies could no longer be found, but the condition of the skin posterior to the sore remained unchanged. The patient's blood was then taken, submitted to the Wassermann test and found strongly positive. A few intravenous injections of "914" with mercurial treatment quickly brought the skin to a satisfactory condition and confirmed the diagnosis of concomitant syphilis, and further anti-syphilitic treatment changed the Wassermann reaction from a strong positive to a negative.

Although these twenty-eight cases might be considered a small number to dogmatize on, I may be permitted to point out the following facts:—

- (1) The series includes cases in all stages of the disease.
- (2) All the cases, except the one mentioned with multiple scars, were diagnosed definitely oriental sore by the microscopic findings of Leishman-Donovan bodies.
- (3) The blood sera from all the cases were examined independently by the Wassermann test at Rochester Row Military Hospital, London.
- (4) The findings of the Wassermann reaction were negative in all the cases examined, except the one recorded with concomitant syphilis.

From these findings it may be confidently concluded that, in the absence of concomitant syphilis, the Wassermann test never gives a positive reaction in cases of oriental sore.

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A CASE OF SEVERE SYSTEMIC GONOCOCCAL INFECTION.

BY CAPTAIN G. H. WOOD.

Royal Army Medical Corps.

THE patient, Cpl. W., aged 19, in the best of health at the time, was exposed to venereal infection on the night of September 13 last, and, owing to circumstances, was unable to take the usual precautions of immediate self-disinfection as practised and taught in the Army to-day.

Six days later he was admitted to King George V Hospital with his first attack of gonorrhœa, never having previously contracted any venereal disease. A thick purulent urethral discharge was present, in which gonococci were present in abundance.

The patient was placed on the routine treatment at the time in vogue for all acute cases of gonorrhœa, i.e., bed, milk diet, barley water, mist. alba mane, and mist. alkalina t.d.s., along with anterior irrigation of the urethra with potassium permanganate solution (1 in 8,000) three times daily.

On the night of the 25th he developed a high temperature and vomited, and by the 27th he had developed a well-marked teno-synovitis, involving both hands.

On the 28th he presented a typical picture of gonococcal rheumatic fever, involving the wrists, ankles, and great toe, with an effusion into the right tensor fasciæ femoris, and a temperature of 101.4° F. at 11 a.m. Aspirin fifteen grains was ordered night and morning and the affected joints wrapped in cotton wool.

On the 29th his condition was unchanged, and two cubic centimetres of intramine were injected intramuscularly into the left buttock, and a mixture of sodium salicylate (ten grains per dose) prescribed, to be taken three times daily.

On October 3, as the pyrexia was continuing unchanged (between 101° and 102° F.), a second injection of intramine was now given; also ten cubic centimetres normal horse serum were injected subcutaneously; at this time the swelling of the left wrist had subsided, but the right wrist remained very swollen and tender, and there was a well-marked teno-synovitis of the tibialis anticus tendon, and also pain and tenderness in the tarso-metatarsal joint of the great toe.

Having proved his tolerance to serum, forty cubic centimetres of normal horse serum were injected on October 5, and the next morning his temperature fell to normal for the first time, and the patient seemed a little better, albeit the right wrist was still very swollen and painful.

The affected joints were kept wrapped in cotton wool, and tinct. iodine was applied daily.

The temperature now began to swing, and from normal in the morning rose each evening to about 101° to 102° F., and the patient complained of the pain in the great toe and right wrist, which was still very tense and painful.

The urethral discharge had dried up some days previously, probably under the influence of the temperature, and so the chance of obtaining an autogenous vaccine was missed. On October 8, twenty-five millions of stock polyvalent gonococcal vaccine (as issued from the Military Hospital, Rochester Row), were injected, and the pyrexia was somewhat abated.

On the 14th, fifty millions of the stock gonococcal vaccine were given, and potassium iodide, seven grains, was added to the sodium salicylate mixture.

By the 17th the pain and swelling in the right wrist were considerably less, and the temperature had fallen to about 99° F., a welcome improvement in his condition, pointing to the success of the injections of vaccine.

As the urethral discharge at this stage returned, anterior irrigations with pot. permanganate (1 in 6,000) were given in bed twice daily.

As the right wrist showed a tendency to drop, a posterior splint was applied, and gentle massage and passive movements were commenced. Absolute rest in bed was rigidly insisted on from the commencement, and the heart was carefully observed for signs of endocarditis. Beyond a slight reduplication of the first sound, during the third week, the action of the heart remained good, and there was no undue acceleration and no precordial pain or palpitation.

On the 21st a further dose of 100 millions of gonococcal vaccine was given, and by the 26th the patient was well enough to be allowed to sit up for a time daily.

The right wrist was much improved, and gentle massage and movements of the joint continued daily, and with increasing strength of the muscles the splint was dispensed with. On this date the urethral discharge had practically stopped, and no gonococci were found.

On October 28 a further 150 millions of gonococcal vaccine were given, and the irrigations were confined to one daily of pot. permanganate 1 in 4,000.

By November 4 the urethral discharge had disappeared and irrigations were discontinued. The right wrist showed some loss of power, but no adhesions, and the patient was sent to the electrical specialist, who gave him radiant heat for ten days. At the end of this time a further dose of 200 millions of gonococcal vaccine was given.

Massage and movements of the joint were kept up for another ten days, at the end of which time the patient was discharged from hospital and returned to his unit.

I am indebted to Lieutenant-Colonel C. J. O'Gorman, D.S.O., R.A.M.C., for help in connexion with and permission to publish this case.

INFANTILE DIARRHŒA.

BY CAPTAIN G. H. WOOD.

Royal Army Medical Corps.

THE following case of severe infantile diarrhœa and the successful use of oral administration of cold tea infusion might be of interest to your readers both at home and abroad:—

A healthy English boy, aged 7½ months, in a Plains Station in the Punjab at the beginning of the hot weather of 1921, was in the early stages of somewhat delayed dentition; his parents, thinking he was not thriving sufficiently on the rather poor Indian milk, added a couple of teaspoonfuls of unsterilized cream to his bottle on three or four occasions, during a couple of days, after which time he developed an acute attack of green diarrhœa which persisted throughout the day,

as a result of which albumen water was substituted for milk for twenty-four hours and a dose of castor oil was given.

An attempt to resume milk feeding the next day was followed by vomiting and increased diarrhœa and all milk was withheld for forty-eight hours, during which time albumen water and chicken broth were given and an emulsion of castor oil was prescribed, given in small doses frequently. At the end of this time the diarrhœa had abated and the boy was given some very weak Glaxo with a view to milk-feeding being resumed. This was followed by vomiting, and diarrhœa set in again more violently than ever with marked tenesmus and frequent liquid green stools with mucus and occasional streaks of blood. Albumen water, rice water, sherry whey, and tartaric acid whey were then resorted to accompanied by the usual antiseptic infantile powders, but the passage of frequent stools of the colour and consistency of chopped spinach continued and was accompanied by vomiting at times. By this time the little patient was becoming very exhausted and emaciated, and high rectal irrigation with normal saline was carried out three or four times daily by means of a No. 25 French catheter; the saline was at first absorbed well and brought about a short refreshing sleep on occasions, and undoubtedly compensated for loss of fluid from the tissues. Daily inunction of the body with olive oil and a little brandy in it was also practised and did much to maintain the body heat. All attempts to control the diarrhœa, however, failed, and the frequent passage of liquid green stools with occasional severe vomiting continued, pointing to a severe ileo-colitis on which the usual antiseptic and astringent drugs, such as bismuth and salol, had no effect. The occurrence of vomiting was a very alarming feature and, though alleviated by sips of weak brandy and water, rendered it practically impossible for powders to be given with any benefit though tried repeatedly. Finally, a slight modification of Roseberry's¹ chlorine water mixture was given as under:—

Quin. sulph.	..	..	..	..	..	½ gr.
Salol	..	..	..	..	..	4 „
Mucilage tragacanth.	..	..	..	..	..	q.s.
Aq. chlori	..	..	..	..	ad	1 ⅓
i. t.d.s.						

This mixture in spite of its unpleasant taste and smell was well taken by the little patient and some slight benefit was also obtained from rectal injection of a thin mucilage of starch containing a drop or two of tinc. opii.

At last about the twelfth day, more in despair than with any real hope of success—the patient being now obviously in extremis, feeds of cold weak tea were commenced—given without milk or sugar as recommended by Lowenberg.² This is made in the ordinary way in a teapot, a teaspoonful of tea-leaves to half a pint of boiling water and left to stand about a minute. It is then poured off through a fine strainer into a half-pint tumbler or small jug and left to cool. This infusion was taken eagerly by the little patient, in sips from a teaspoon as he was too weak to pull it from a bottle, and in the first twenty-four hours the number of

¹ *New York Medical Journal*, 1918, ii, 7.

² *Boston Medical and Surgical Journal*, 1917, ii, 739.

motions decreased from fourteen to six, the colour changing from green to brownish black, the so-called characteristic "tea" motion. About one and a half to two pints of this cold tea infusion were taken during this time and its effect was most striking, right from the commencement.

The patient seemed stronger and its sedative action was very marked, not only on the bowel, but also on the entire system, as he slept for the first time during the illness and there was complete cessation from the twitchings of the eyes and movements of the hands bordering on subsultus tendinum, which signs of severe constitutional disturbance had been such a disquieting feature the few previous days. It was considered advisable to continue the tea infusion for another twenty-four hours, during which time the number of stools decreased to four of the same characteristic dark colour; this time, as the little patient seemed not to be taking the feeds so well, a very small quantity of sugar was added—no saccharine being available.

A cautious start was made next day with feeds of albumen water and whey, followed in a couple of days by very weak Benger's Food, which had previously stood half an hour before boiling in order to allow digestion. No relapse occurred, and from that day the little patient never looked back. The Benger's feeds were gradually increased in strength with less and less use of the digestive enzyme, until finally equal parts of milk and water were given with no ill effects. The great heat of the Indian summer coming on was a matter for great anxiety during the convalescent period, but finally the boy was embarked for England on May 21 at Bombay on whole milk feeds with no further recurrence of diarrhœa. He suffered terribly from insomnia during the first period of convalescence, but this gradually passed off as he regained his natural body weight.

Bottles of sterilized cows' milk were obtained from the dairy at Aligarh for him for the homeward voyage, and when he landed in England in June he was little the worse for his severe illness which had nearly prevented him ever seeing his native land and in the recovery from which, in my firm opinion, the use of cold, weak tea infusion as described above played an absolutely decisive part.

I am indebted to Major W. M. Chesney, M.C., R.A.M.C. (retired), for permission to publish this case.

The tea treatment, though widely practised in America, and, I believe, in Germany, does not appear to have been much used in this country, although our infant mortality from so-called summer diarrhœa is undoubtedly high. The mode of action is peculiarly interesting and I am of opinion that the small quantity of caffeine tannate in solution acts first of all as a stimulant by virtue of its caffeine and, in addition, as a definite intestinal antiseptic and astringent by virtue of its tannin element.

Major Chesney thought that the chief factor was the starvation diet it entails, but my own belief is that it has definite action as noted above, and that as such it has a very distinct advantage over other forms of starvation diet, i.e., albumen water, whey, etc. The fact that infantile diarrhœa has never been brought home to any particular bacterium does not rule out of court its undoubted infective origin which is, of course, aggravated and flared up by errors and indiscretions in feeding, and the fact that milk products in any shape or form constitute a favourable pabulum for the growth and development of the infecting organisms, as evidenced by frequent relapses caused by too early a resumption of milk feeding, contribute to

the belief that the tea treatment, bringing into the infected area as it does an absolutely foreign substance, is definitely hostile to the infecting organisms and rapidly causes their destruction ; as such it is likely to become a valuable factor in the treatment of severe infantile diarrhoea.

REPORT OF A CASE OF CONVULSIONS IN A CHILD TREATED WITH LUMINAL.

By COLONEL G. T. RAWNSLEY, C.B., C.M.G.

THE patient, a little girl, aged 10 years, had suffered from convulsions since May, 1920. There is a complete absence of any family history of epilepsy.

The first seizure ushered in a severe attack of whooping cough at the age of $8\frac{1}{2}$ years. The attacks were at first only every six weeks almost to the day, and always occurred between 5.15 and 5.30 a.m. and singly. Subsequently attacks became more and more frequent, until as many as three a day occurred, severe in character and accompanied by much cyanosis.

The patient is a particularly bright and intelligent child, and seemed in no way mentally affected either before or after the attacks.

On account of the inadequacy of all treatment, viz., bromides, arsenic, dieting, etc., it was decided to place the child on luminal, a drug which is now highly recommended for such cases.

On August 14, 1921, this child was placed on luminal. The last attack prior to this new treatment was on August 9, 1921, on which day there were two very severe attacks. The dosage was 1 grain at night with a weekly purgative. Attacks since have been very mild and few and far between, and in no case has consciousness been lost, and there has been only a trace of momentary spasm in the arms.

On August 22, 1921, there were two such mild attacks at 2 p.m. and 5 p.m. Luminal was therefore increased by $\frac{1}{2}$ grain every morning up to September 5, 1921. The child kept absolutely free of all attacks and giddiness. On that date there were two mild attacks of giddiness, and so the luminal was increased by $\frac{1}{2}$ grain, the dose therefore being 1 grain morning and evening.

During September the child, who is myopic and astigmatic, was seen by an oculist, and her glasses were found to need correction. This is always seen to annually.

There have been further occasional mild attacks of a transitory character with giddiness and slight momentary spasms of the arms, but no loss of consciousness, viz., on September 24, 1921, October 9, 1921, and October 25, 1921, also at intervals, occasional attacks of giddiness only.

The child is now taking luminal in 1 grain doses t.d.s., and having a weekly purge. She looks in good health and is attending school regularly.

Luminal or methyl-barbituric acid has a powerful controlling action, as is seen ; this is the opinion of other local medical men who are using the drug and who have had similar results to the present case.

On August 27, 1921, an article appeared in the *British Medical Journal* headed "Luminal contrasted with Bromide," by F. Golla, M.D., F.R.C.P., Physician to

St. George's Hospital, London, who recorded results in about 180 cases, of a like nature to those obtained in Guernsey.

Dr. Golla stated that the drug was apt to cause giddiness, and in some cases he had been obliged to cease giving it on this account. Our experience locally is that this is an indication to increase the dose, and we have found this symptom then subsides, without ill effect to the patient; on diminishing the dose again we have found the giddiness recur.

It would seem therefore that this drug converts "grand mal" attacks into "petit mal" attacks rather than that it is the cause of the giddiness.

Lecture.

GAS WARFARE.

BY MAJOR W. R. GALWEY, O.B.E., M.C., R.A.M.C.

LECTURE III. THE TREATMENT OF GAS CASUALTIES—EARLY AND LATE.

BEFORE the foundations for a rational treatment of cases of asphyxiant gas poisoning can be laid, a clear idea must be formed of the causes which are operative in threatening the life of the patient.

It is agreed that the seriousness of the case varies with the degree of want of oxygen which is present, and treatment must therefore be directed to prevent the development of this condition or to relieve it when established, and so give the patient time to mobilize his reserves to fight and defeat it.

Recent research into the physiology of normal respiration has thrown much light on the causation of and symptoms produced by oxygen want, and in addition has explained such well-known clinical phenomena as periodic or Cheyne-Stokes breathing and orthopnoea.

It is necessary to refer briefly to the factors which regulate normal breathing to understand the sequence of events in asphyxiant gas poisoning.

When, on inspiration, the lungs expand to a certain point, expiration is initiated; similarly, on collapse to a certain point inspiration begins. The nervous impulses concerned are carried by the vagus nerves, but the reflex itself is controlled by the action of the carbon dioxide in the blood on the respiratory centre.

A certain percentage of CO_2 in the blood is necessary to fire off this reflex, and if too much CO_2 is washed out of the blood—as, for instance, in forced breathing—the subject goes into apnoea until sufficient CO_2 again accumulates to fire off the reflex.

On the other hand, a very small increase in the pressure of CO_2 in the blood—0.2 per cent—will double the respiratory ventilation, increasing both the depth and rate of breathing. Anything, therefore, which interferes with the normal discharge of CO_2 from the lungs will bring about hyperpnoea.

What the respiratory centre really responds to when it reacts to increase of CO_2 is the balance of the hydrogen ion concentration in the blood. To any alteration in this balance the respiratory centre is extremely sensitive, and the increased breathing in the presence of increased CO_2 is an effort of the body to reduce the hydrogen ion concentration by washing out the carbon dioxide.

In spite of the fact that different parts of the lung are unequally ventilated, it has been shown that the percentage of CO_2 in an average sample of alveolar air from a normal individual is relatively constant.

Though a definite percentage of CO_2 is normally necessary to fire off the respiratory reflex, it has been proved that it responds to a lower percentage in the presence of lack of oxygen. The first response to this condition is therefore an increased depth and rate in breathing owing to the lowered "threshold value"—as it is called—of CO_2 .

As the condition of oxygen lack develops the next response is periodic breathing unless the want of O_2 is considerable, when a condition of rapid shallow breathing is established.

When the blood comes in contact with the air in the lungs it takes up oxygen and gives off CO_2 . CO_2 is much more readily diffusible than O_2 and much more can be stored in the body, which has a relatively small capacity for storing O_2 .

When, therefore, there is interference with respiratory exchange the main effect is on the O_2 intake rather than the CO_2 output unless there is considerable blocking of air passages which prevents air leaving large numbers of alveoli.

To turn now to the tissues. The blood gives up its oxygen in them more rapidly and effectively in the presence of CO_2 ; if, therefore, from any cause, as by increased ventilation, the CO_2 is washed out of the blood, it will then part less readily with its oxygen. If, in addition, the supply of oxygen itself is diminished the tissues quickly suffer from the lack and their functions are disturbed. A slight diminution of oxygen is more quickly felt and has more serious effects on such organs as the brain, particularly the vital centres such as the respiratory, and on the heart. A vicious circle is thus set up; the lesion in the lungs interferes with the respiratory exchange, this in its turn reacts on the vital centres with a resulting diminution in the efficiency of the ventilation of the lungs and the circulation of blood through the body.

The circulation itself is regulated in the main by the rate at which the tissues allow blood to return to the heart, rather than by the heart itself which simply pumps at increased pressure the blood delivered to it. The rate of delivery from the tissues is regulated by:—

- (1) The degree of saturation of the blood with oxygen; and
- (2) The degree of saturation with CO_2 and consequently its reaction in the capillaries.

The capillaries do not merely react passively to blood pressure but actively contract and dilate.

We have now, I think, sufficient data to understand what happens in asphyxiant gas poisoning and why the serious cases fall into two main groups:—

- (1) Those with purple-coloured cyanosis, distended veins, hyperpnœa, and evident distress; and
- (2) The grey cases, with pallid lips, shallow breathing, but no distension of the veins and little respiratory distress.

The latter being the more serious.

Remember the anatomical conditions which occur—the acutely inflamed condition of the air passages, particularly in poisoning by chlorine; the damage to the alveolar epithelium, particularly with phosgene, the engorgement and thrombosis of capillaries with flooding of the lung by œdema. These bring about a condition in which both the pulmonary circulation and the respiratory exchange are interfered with. Owing to the swelling and exudation oxygen cannot get through quickly enough to the blood to saturate it during its passage through the pulmonary vessels. The damage to the capillaries causes leakage of fluid, and, in consequence, the blood is more concentrated and its volume is reduced below the danger point. As the heart fails there is cardiac inhibition and loss of vasomotor tone.

The hyperoxæmia of concentration does not compensate for the anoxæmia due to unsaturation, but does make for stagnation by throwing more work on the heart.

A combination of the types of want of oxygen—anoxæmia—which Professor Barcroft describes as the most serious consequences of gas poisoning, are thus brought about: (1) The anoxic type in which the oxygen pressure in the blood is too low the hæmoglobin is not saturated and the blood is dark; and (2) the stagnant type where though the blood is normal it is supplied in insufficient quantity.

Besides the lack of saturation of the blood with oxygen the discharge of CO_2 from the lungs is also interfered with, and this is the main cause of the hyperpnœa. The lack of oxygen causes failure of the right heart which is then unable to cope with the increased work of pumping blood through the œdematous lung. As the right heart fails the superficial veins become distended and if there is retention of CO_2 the capillaries will also dilate.

The causes then underlying the symptoms of the first group of cases—those with plum-coloured cyanosis—are (1) lack of oxygen, (2) retention of CO_2 , and (3) failure of the right heart.

So long as the heart is not losing much ground and the lack of O_2 is not extreme the cyanosis will remain plum-coloured.

Owing to bronchitis, emphysema and areas of relative collapse in cases of chlorine poisoning there is probably more CO_2 in the alveoli which are still permeable, whereas in phosgene poisoning the injury to the air passages being less there is less likelihood of retention of CO_2 , but the lack of oxygen is greater since the alveoli are more damaged. There is therefore in phosgene poisoning a greater likelihood of the second type of cases—the grey type. In these the lack of oxygen is more profound and the breathing therefore becomes rapid and shallow. There is practically no hyperpnœa because the increase of breathing washes out the CO_2 from the blood. For the same reason there is little distension of capillaries.

But the lack of CO_2 causes the blood to part less readily with its O_2 to the tissues. If there is less CO_2 in the alveoli the blood takes up O_2 more readily and the arterial blood will be redder, but since there is less CO_2 in the capillaries the blood parts with its O_2 less readily and the want of oxygen becomes more serious.

With an equal degree of de-oxygenation of the oxy-hæmoglobin there is less free O_2 in the blood when little CO_2 is present or when blood is a little more alkaline than when more CO_2 is present or the blood is a little less alkaline.

There has been a considerable amount of controversy on the question of acidosis in cases of irritant gas poisoning.

Professor Haldane points out that the increase of circulation and respiration caused by the want of oxygen diminishes the CO_2 in the tissues and brings about a condition of alkalosis as indicated by the urine becoming less acid or alkaline and the NH_3 formation in the body sinking to a minimum. The alkali reserve of the body gradually diminishes, that is to say the amount of soda available for combination with CO_2 .

On the other hand, lack of oxygen does produce acidosis, and Professor Barcroft found evidence of acids other than carbonic acid in the blood.

How then does the subject combat these conditions? In three ways:—

- (1) By increasing his ventilation.
- (2) By increasing his circulation.
- (3) By the consolidation or shutting off of the injured area of lung.

(1) *By Increased Ventilation.*—As soon as the oxygen want begins to develop the subject breathes more quickly, partly owing to the fact that CO_2 has a lower threshold value in the presence of slight lack of oxygen and partly owing to the stimulus of oxygen-want itself.

The increased ventilation raises the pressure of O_2 in the lungs and reduces the lack of oxygen and tends to stave off its more serious development.

(2) The circulation rate is increased and if a blood gas analysis is made in a patient who is maintaining his position it will be found that the venous blood contains more O_2 than normal. This is not because the tissues are using less oxygen, but because the blood is being propelled round the body more quickly.

(3) So long as the respiratory centre and the heart can withstand the strain involved until the third line of defence is established, the patient will make good. This third line of defence is the shutting off of the damaged area of lung. As I described in my last lecture the alveoli most affected become consolidated and the blood practically ceases to flow through them. Others less affected clear up and the patient carries on with less available lung substance until the œdema is absorbed and the lung becomes practically normal, as it does in the majority of gassed cases which recover, though some may have scar tissue and emphysematous areas.

We can now formulate a rational line of treatment for cases of asphyxiant gas poisoning, and modify it according to the need of individuals.

(1) The first point in treatment should be to diminish the patient's need of oxygen by every possible means—by keeping him at rest and by warmth. To keep him at rest necessitates a special organization for evacuation of gas casualties when these occur in numbers, and I shall hope to refer to this again in my last lecture. Warmth can be given by means of hot water bottles or by preparing a stretcher with folded blankets and applying warmth by means of a Primus stove as was done in cases of surgical shock. If circumstances permit patients should not be evacuated to the lines of communication until all serious symptoms have disappeared.

(2) The next and most important point is the administration of oxygen. But on service, oxygen is difficult to obtain in large quantities and also difficult to transport. What then should be the indications for administration of oxygen?

If a patient has no cyanosis—whether of the plum-coloured or pallid variety—

oxygen is not necessary. If he has cyanosis oxygen is necessary and should be given at the earliest possible moment to prevent the vicious circle initiated by even slight anoxæmia.

This is most easily and economically given by the portable apparatus devised by Professor Haldane, and with comparatively little trouble an installation can be arranged so that two or three orderlies can attend to a number of patients.

The administration should be begun early and should be persevered with, even though apparently there is little improvement in the patient. Remember that lack of oxygen may have already done damage to important structures and organs and that it will take the patient time to recover from this even though oxygen administration may prevent further damage.

Usually a delivery rate of two to three litres per minute is a sufficient dose, the mask being withdrawn for five minutes every half-hour. In very bad cases up to five litres per minute have been given with excellent results.

Once the patient regains his colour and his pulse improves and the improvement is maintained oxygen may be stopped; but any return of the symptoms indicates resumption of the administration.

Oxygen is itself irritating to the lungs in large quantities and should not therefore be pushed further than necessary.

Before leaving this treatment it is only fair to say that in a series of experiments carried out on dogs exposed to standard doses of gas by Underhill, the American observer, he found that administration of oxygen neither delayed the time of death nor increased the percentage of recoveries. Clinical experience in France, however, proved beyond doubt the value of this treatment. Again and again apparently hopeless cases recovered when oxygen was given efficiently and over long periods.

Venesection.—Clinical experience in France was in favour of bleeding in irritant gas poisoning, but not as a routine treatment in all cases. It is certainly justifiable in cases with venous congestion to relieve an overburdened right heart. The quantity removed should amount to twenty ounces—about 550 cubic centimetres; and the bleeding should be done slowly—about twenty minutes for the quantity mentioned.

In the pallid cases the treatment was not considered justifiable. On the other hand the work of Underhill in the treatment of gassed dogs brings forward very strong evidence in favour of early bleeding, and still stronger evidence in favour of bleeding and injection of saline. In phosgene poisoning he found that in many cases early bleeding was sufficient to save the animal, whereas in chlorine, bleeding plus infusion was indicated. The reason he gives for this difference is that in phosgene poisoning there is in the early stages a preliminary dilution of the blood—the fluid being probably withdrawn from the tissues—before the stage of blood concentration and stagnation sets in. Early bleeding to 0.5 per cent of the body weight of the animal relieved the distension of the heart and in many cases this treatment sufficed. In some cases, however, the condition of dilution recurred and was always accompanied by a rise of temperature. When this happened he bled the animal again and even repeated the procedure a third time until blood to 1.5 per cent. of the body weight had been withdrawn. If after this the stage of concentration occurred he infused or injected intra-peritoneally normal saline.

In chlorine poisoning he did not find this stage of early dilution occur. The blood immediately began to concentrate and for this reason he bled the animal and infused a quantity of normal saline equal to the amount of blood withdrawn.

There are obvious objections to adopting this as a routine treatment in the case of human patients. To begin with the personnel required would be very large when gas cases were numerous. Nor does experience in France go to show that bleeding was necessary in all cases.

One thing is, however, fairly certain, i.e., that in the early stages of blood concentration and stagnation bleeding does no harm, and that bleeding and infusion with saline will probably do good by increasing the volume of circulating blood.

The experimental evidence goes to show that normal saline is the best diluting fluid to employ.

Drugs.—The inhalation of *ammonia vapour* often gives relief in the early stages of chlorine poisoning. It probably acts more as a stimulant than in any other way. It should not be given in too strong a concentration and if it increases the cough or dyspnoea it should be withdrawn.

Atropine was tried as a means of relieving the bronchial spasm which sometimes occurs, but little benefit appears to have been gained by its use.

Cardiac Stimulants.—Brandy has proved very effective. Pituitrin 0.5 cubic centimetre hypodermically, at intervals of not less than three hours; hypodermic injections of camphor, or caffeine have been well spoken of. Neither strychnine nor digitalis proved of much value.

Morphia should only be given in cases of extreme restlessness, and then the dose should be small.

Expectorants should be given with caution. Their use in the first two days is contra-indicated for fear of increasing the damage to the lung by coughing.

Aspirin and phenacetin should not be used to relieve the headache which occurs.

Such methods as emetics, tickling the throat, and posture to aid the drainage of fluids from the lungs have been used with success.

Food should only be given in fluid form and sparingly in the acute stage and the diet should be light till convalescence is well established.

There seems to be little to be gained by any form of treatment specially designed to correct the accumulation of carbonic acid or other acids in the blood.

TREATMENT OF THE LATE EFFECTS OF GAS POISONING.

Apart from the treatment of the neurasthenic symptoms and functional disturbances which appear in certain patients during convalescence and which I shall refer to when dealing with the treatment of mustard gas poisoning, there is evidence to show that the cases of cardiac disturbance and spasmodic dyspnoea are due to chronic lack of oxygen.

Observations on these patients have shown that their breathing is much shallower than that of normal persons and shallow breathing is a cause as it is also a result of lack of oxygen.

It may be that during the acute stage the respiratory centre has been so damaged that the reflex controlling inspiration and expiration becomes abnormally

sensitive and fires off before the normal distension or collapse of the lung has been reached.

The lack of oxygen is not due to the anatomical condition of the lung itself, for in the great majority of cases, if the patient survives, the lung quickly returns to normal and very little permanent damage remains.

The shallow breathing is accentuated by the lying posture and this explains the dyspnoeic attacks at night.

The condition is markedly relieved and in many cases was cured by administration of oxygen either by means of a Haldane apparatus or by making the patient sleep in a special chamber in which the atmosphere was enriched by oxygen.

Moreover, experiments on an ergometer showed that patients suffering from the effort syndrome could perform more work without dyspnoea if given inhalations of O_2 .

VESICANTS.

Mustard Gas Poisoning.—The time at our disposal does not permit of more than an outline of the lesions and associated signs and symptoms due to poisoning with mustard gas; but to those who wish to study the subject further I would recommend an article by Drs. C. M. Wilson and J. M. Mackintosh in the *Quarterly Journal of Medicine*, vol. xiii, No. 50, January, 1920.

At the time of exposure to this gas nothing is noticed save the faint smell usually likened to garlic or mustard.

After a lapse of two to three hours symptoms begin to make their appearance and the intensity and duration depend upon the concentration of the gas.

The eyes usually are the first to show signs of the mischief—an acute conjunctivitis, which develops rapidly. There is extreme lachrymation accompanied by headache. Blepharospasm is marked. From the second day the discharge is muco-purulent and the injury may go on to corneal ulceration, but this complication is not common. Later photophobia of functional origin develops in a considerable number of cases.

Coinciding with the development of eye symptoms there is nasal catarrh, and sneezing is frequent. Nausea, retching and vomiting with epigastric pain are common at the same period.

During the next few hours other signs and symptoms make their appearance. The throat feels dry and burning, the voice becomes hoarse and a brassy cough develops.

A red erythema appears on the skin of the face and neck, and other parts of the body (particularly where the skin is moist) are similarly affected. Small blisters and blebs appear later in these areas. In the early stages the condition resembles the rash of scarlet fever.

During the second twenty-four hours the vesicles develop into large blisters while the scrotum and penis, if affected, become oedematous and painful.

Respiratory signs now appear with the onset of bronchitis and in the muco-purulent sputum large sloughs from the inflamed tracheal lining may be found.

Secondary infections of the respiratory tract varying from purulent bronchitis through broncho-pneumonia to bronchiectasis and even gangrene of the lungs supervene and cause death.

The temperature, pulse, and respiration rates vary in accordance with the character and severity of these affections.

Post mortem.—The most important changes are found in the respiratory tract. Throughout its entire length it is acutely inflamed and covered with a yellowish-white false membrane, representing the disintegrated and desquamated epithelial lining mixed with a fibrinous exudate. On removal of this membrane a red granulating surface is exposed sometimes pitted by small ulcers. The lumen of the trachea is filled with a thin pus, and pus can be squeezed from the bronchioles when the lung is cut.

The lungs are voluminous, but they do not exhibit the massive œdema characteristic of the asphyxiant gas cases.

In early deaths small hæmorrhages may be found and scattered areas of emphysematous and collapsed alveoli.

As the secondary lung infection extends, the appearances are those of typical broncho-pneumonia, going on in some cases to small abscess formation.

The Alimentary Tract.—Although vomiting and retching are early signs of mustard gas poisoning they do not as a rule persist after the first twenty-four hours.

According to English observations a true gastritis is rare, though it does occur. French writers on the other hand state that in their view the digestive system frequently participates in the syndrome; gastric pain and discomfort and diarrhœa, often bloody, help to weaken the patient, and when there is a general affection of the skin produced by mustard gas, and not a purely local one, the digestive apparatus is always involved. In their view the lesions in the digestive tube are sufficiently marked to account for the symptoms. The gastric mucosa has lost its sheen and is dark in colour; ecchymotic areas and sometimes true ulcers are found.

German observations do not support this view. In this connexion one may say that apart from the mustard gas which may be actually swallowed with saliva, there is experimental evidence to show that di-chlor-ethyl sulphide when injected subcutaneously appears to be absorbed and excreted by the mucosa.

The Americans claim to have obtained systemic effects which are quite characteristic and unmistakable on the heart, alimentary tract and central nervous system. They state that these effects are produced by hydrolysis—the mustard gas being broken up into hydrochloric acid and a body which can be recognized by converting it back again into mustard. And that the products of hydrolysis are found in the urine. The time taken for a solution of mustard gas to hydrolyse in vitro corresponds with the time taken for symptoms to appear after exposure to the vapour. The experiments are not yet conclusive, but the Americans hold that the evidence already to hand strongly supports their view.

Urinary System.—Albuminuria is present in serious cases as an early symptom and if persistent is a sign of grave import.

Acute hæmorrhagic nephritis has been described.

Circulatory System.—The heart is unaffected at first, except by changes associated with the pulmonary complications. Later, in convalescence, symptoms of D.A.H. and the effort syndrome are observed in a considerable number of cases. Observers are agreed that these symptoms are of nervous origin, and depend largely on the methods of treatment adopted in the early stages.

Blood Changes.—The leucocyte count is of importance in mustard gas poisoning.

In the early stages, from the first to third day, occasionally later, there is a great leucocytosis which may rise as high as 35,000. The increase is due to the polymorpho-neutrophiles, which number about ninety-eight per cent of the total.

Even when the total count is not raised there is a relative increase in these cells.

The lymphocytes are reduced in numbers; eosinophile and basophile cells practically disappear. The large mononuclears remain either normal or are reduced.

In serious cases a fall in the leucocyte count beginning about the third or fourth day is a sign of bad omen, unless there is marked improvement in the patient's condition; and a leucopænia occurs just before death.

There is no change of note in the red blood corpuscles. But the coagulation time of the blood is said to be markedly diminished.

TREATMENT OF CASUALTIES FROM MUSTARD GAS.

Immediately on arrival at the gas casualty centre, or, if practical, at the aid post or advanced dressing station, steps should be taken to get rid of all traces of mustard gas from the patient, his clothing, and equipment.

I have already dealt with the methods of disinfection of clothing, and need only add that when clothing is taken from the patient it should *at once* be disposed of in a safe place where it cannot injure others by continuing to give off gas.

The patient should then be washed from head to foot with warm soapy water to which bicarbonate of soda 20 parts per 1,000, or lime water 1 part per 1,000 has been added. Particular attention should be paid to his hands which may be infected, lest by scratching he convey the poison to other parts of the skin.

He is then dried and put to bed in clean clothes.

Care should also be taken to prevent injury to the personnel attending to the patient.

The conjunctivæ should then be washed well with a two per cent solution of bicarbonate of soda or warm boric lotion, and liquid paraffin instilled. This treatment should be frequently repeated, particular attention being paid to the corners and the eyelids being everted, if possible. If liquid paraffin is not available castor oil may be used but is more irritating.

If the cornea is affected, one per cent sterile atropine ointment should be used instead of paraffin, and repeated sufficiently often to keep the pupils dilated. Cocaine should not be employed. Washing with potassium permanganate 1 in 4,000, or the application of an ointment containing potassium permanganate or methylene blue are recommended.

If the discharge becomes muco-purulent, two per cent solution of argyrol or protargol should be applied once a day.

The eyes should never be bandaged. Dark glasses or shades may be given for the first two or three days, but should be dispensed with as early as possible. The photophobia which follows the affection of the eyes is nearly always functional, the patients are in a very suggestible condition, and unless a firm attitude is adopted and an atmosphere of cure established at once by impressing on them that the injury will not be permanent a neurasthenic condition develops which

is very intractable and prolongs convalescence indefinitely. Plunging the head into cold water with the eyes open often cures these functional symptoms.

The nose and naso-pharynx should be washed out with warm alkaline solution three times a day. This should be poured in, not snuffed up.

Relief to the condition of the larynx may be obtained by inhalation of steam from boiling water to which an ounce of tincture benzoin co. and ten grains of menthol have been added. The French recommend a laryngeal injection of gomenol oil one to two cubic centimetres daily.

The laryngitis usually clears up in a fortnight, but a functional aphonia may develop which is best treated by strict methods.

Tracheitis may be eased and the risk of secondary infection lessened by the use of a perforated metal mask moistened with drops of an antiseptic solution, such as :—

Menthol	..	..	..	..	..	20 gr.
Tinct. iodi.	..	..	..	..	..	30 min.
Oil of eucalyptus	..	..	..	..	..	30 min.
Creasote	..	..	..	..	..	1 dr.
Chloretone	..	..	..	..	..	1 dr.
Alcohol to	..	..	..	..	..	1 oz.

When secondary infections such as broncho-pneumonia occur the appropriate treatment should be given. Venesection or oxygen may be used if cyanosis develops, but these measures are never called for in the early stages of mustard gas poisoning.

The vomiting and other symptoms arising from infection of the alimentary tract may be relieved by warm draughts of a solution of bicarbonate of soda.

The diet in the early stages should be mild and light. Indeed, inflammation of the posterior pharyngeal wall may make swallowing a matter of difficulty.

Skin Lesions.—After the initial washing with soapy water and bicarbonate solution, a dusting powder of boracic acid chalk starch and zinc oxide or calamine lotion should be applied to relieve irritation. Fatty ointments give no protection against the poison.

Small burns heal well under Lassar's paste with two per cent salicylic acid.

Washing with four per cent solution of potassium permanganate and applications of ambrine have also been recommended, but before the latter is applied care should be taken to render the skin aseptic.

Large excoriations or areas with pyogenic infections should be treated by soaking with boracic lotion for a short period and then applying zinc ointment with ammoniated mercury.

Functional Symptoms.—Mustard gas cases are very liable to develop during convalescence hysterical symptoms, such as vomiting, photophobia, aphonia or D.A.H. and it is of the greatest importance to remember this and frame the early treatment, so that what the French describe as "benign contagion"—an atmosphere of cure—is established at once.

Unless this is done, not only may the patient remain in hospital, but he may become a confirmed neurasthenic.

In France it was found that by adopting a strict and hopeful attitude, a very large majority of the cases of mustard gas poisoning were fit for discharge from hospital within four to six weeks. In England, on the other hand, many cases were still unfit at the end of twice or three times that period. Allowing for the

fact that the most serious cases went to England, this period is too long, and investigation proved that a great number were suffering from neuroses.

How far these neuroses are the result of gas or of general war strain is a matter of doubt. In any case, the neurotic element should never be forgotten in gas poisoning.

Being a new weapon it was naturally very terrifying, and the fact that unless in large concentrations the smell was almost imperceptible kept men in a state of expectant strain. Many men thought they were gassed when they were not, and towards the end of the war it became necessary to send men to the gas centres diagnosed N.Y.D. gas or query gas just as they were sent to the neurological centres diagnosed N.Y.D. nervous. In such cases it only required a little injudicious sympathy to bring about a nervous breakdown with all kinds of symptoms which were merely manifestations of a conversion hysteria.

I have mentioned D.A.H. as one of the neurasthenic manifestations in the late stages of mustard gas poisoning.

As far as can be judged this syndrome did not arise from the same cause as the D.A.H. of cases of irritant gas poisoning. In the latter it appears to have been consequent on the lack of oxygen in the early stages which having upset the nervous reflexes gave rise to chronic shallow breathing. In the cases of mustard gas, on the other hand, it appears to be a symptom of the general neurasthenic condition of the patient.

It is well then whilst adopting energetic treatment of actual lesions to restrain over-sympathy with the patient and to impress upon him that he will in all probability shortly be quite fit to return to duty:

Chlorarsines.—When the blue cross shell was first introduced the effects were limited to irritation of the eyes nose and throat and a burning pain in the chest. These symptoms were transitory and did not produce serious casualties.

Later, however, definite symptoms of poisoning by these compounds were observed and were probably due to the introduction of ethyl-di-chlorarsine or to drinking of water contaminated by the blue cross shells.

These symptoms were as follows: Burning pain in the nose, mouth, and throat; smarting of the face; aching pain in the eyes with intense lachrymation and mild conjunctivitis; frontal headache and copious watery discharge from the nose; burning pain in the chest; salivation; pain in the stomach, nausea and vomiting.

In some cases sensations of pins and needles were experienced, or temporary numbness and loss of power in the limbs without the sensation of pins and needles giving place to aching pain but with no tenderness of the main nerve trunks.

A curious symptom is the extreme degree of mental misery to which exposure to this compound gives rise.

These symptoms are in the main transitory and in many cases were not sufficient to cause evacuation of the patient, or at the worst cleared up in a few days, except in those patients who developed neurasthenic symptoms which were rather attributable to general war strain and weariness than to the action of the gas.

In a certain proportion of cases alterations of sensation and of reflexes appear in the late stages, but authorities are agreed that the lesions cannot be attributed to a definite arsenical neuritis, and that they are probably functional in origin.

Such is the clinical picture of the casualties inflicted by the enemy use of the arsine compounds; but there is definite experimental evidence to show that these compounds can cause much more serious symptoms and may be lethal.

Pathological examinations of animals which succumbed to the effects of these compounds show that lesions occur in the respiratory tract which are sufficient to cause death. Pulmonary œdema is common and frequently severe, but the chief feature is serious damage in the upper air passages.

Frequent exposure apparently increases susceptibility to their effects.

Current Literature.

Relapsing Fever.¹ *Ætiology.*—According to Willcox, the danger of infection by the breath, excreta, blood, etc., from a patient suffering from acute symptoms and who has been effectively deloused, is greater in the case of relapsing fever than in typhus. He has seen several cases in which those nursing relapsing fever patients have contracted the disease in spite of every precaution taken as regards lice, and he has met with two cases in which bacteriologists developed the disease after taking blood-films from relapsing fever cases, the usual incubation period intervening. A medical officer who accidentally got some blood on his hands, on which there were some abrasions, had an incubation period of five days. The spirochæte of relapsing fever may possibly gain entrance through the unbroken skin, like the spirochæte of hæmorrhagic jaundice.

Cragg, of the Central Research Institute, Kasauli, states that relapsing fever occurs over the greater part of India with the exception of Assam, Bengal, and Madras. Isolated cases and small outbreaks are frequently reported among troops and followers, and in jails in Northern and Central India and in the Deccan. Its occurrence is not determined by climatic conditions, for it is not an uncommon disease in states so dissimilar as Bombay and Quetta. The disease appears to be more serious in the United Provinces than elsewhere. Unlike the relapsing fever of Europe, North Africa and America, where it is more prevalent in winter, the epidemics in the United Provinces occur mainly in the hottest part of the year, in the months of March, April and May. Although the rôle of the louse has been fully established in the winter epidemics of relapsing fever in Europe, North Africa, and America, Cragg maintains that it is very unlikely that this parasite is the transmitting agent in the hot weather epidemics, when lice are comparatively scanty in number. He considers that their scarcity accounts for the failure of the disease to take hold in the Ahmednagar camps, where most of the cases occurred singly or in small groups, in marked contrast with the outbreaks in the Bijapur jail in 1901 with 323 cases, and in the "Deccan Gang" in 1902 with 210 cases, which were probably examples of classical relapsing fever transmitted by the louse. It is probable that the relative immunity of the troops from relapsing fever is due to the greater cleanliness of their habits as compared with those of the rural community from which they came.

According to Manson and Thornton, in their study of East African relapsing fever, the tick *Ornithodoros moubata* was the only carrier of infection in the Dar-es-Salaam area whereby the disease was spread. Other possible carriers, such as lice, bed-bugs, fleas and chiggers, were investigated, but showed no evidence of any relation to the disease. The number of these insects did not bear any relation to the incidence of relapsing fever, nor was the *Spirillum duttoni* found in any of them.

¹ Reprinted from *Medical Science*, vol. v, No. 2, November, 1921.

Symptomatology.—During 1917 and 1918, Caldwell had the opportunity of studying 125 cases of relapsing fever among British and New Zealand troops at the 27th General Hospital at Cairo. Sixty-nine cases were of the Egyptian or North African type and fifty-six of the Palestine type. In the Palestine type, which has not hitherto been described, the initial symptoms resemble those of the North African relapsing fever. Pain over the liver is more frequent, and the organ is more often enlarged, while enlargement of the spleen is the exception. The initial fever is considerably shorter than in the North African type, lasting two to four days and ending by crisis. Slight jaundice, often merely conjunctival, occurred in twenty-five per cent of the cases. The average number of relapses in Caldwell's cases was 4.5 as compared with 1.35 in the North African type of the previous year, and treatment by kharsivan undoubtedly cut short the number in several cases. The apyrexial intervals were very irregular, and, unlike the North African type, there was little tendency to a regular periodicity, the intervals tending to become longer in the latter relapses, but not invariably so. Afebrile periods lasted from two to twenty-seven days, but a relapse rarely occurred after fourteen days and still more seldom after twenty-one days.

Newcomb describes an outbreak of sixty-six cases which occurred in the northern part of Mesopotamia in April to June, 1918 with only one death; sixty-five of the cases were in men and one in a woman. In the duration of the attacks and intervals, as in the symptoms, the cases corresponded to the classical description given by Vandyke Carter in 1882, and those of most subsequent observers. In the cases which relapsed after a dose of neosalvarsan the relapse was delayed from fourteen to thirty days (average nineteen days) as compared with an interval of five to twelve days (average 6.8 days) in cases not treated with neosalvarsan. In view of the long interval Newcomb suggests that the "relapses" were really reinfections, especially as little or no immunity is conferred by an attack.

In an article on the occurrence of relapsing fever in home hospitals, Hesse records four cases of soldiers repatriated from the Ukraine, and admitted to a hospital in Germany as convalescents from typhus, who subsequently developed peculiar rises of temperature. Examination of the blood in each case showed the presence of the spirillum of relapsing fever. In three cases the original disease was undoubtedly typhus, and the Weil-Felix reaction was still positive. In the fourth case the rise of temperature in the home hospital was a second attack of relapsing fever. Such cases indicate the necessity of thoroughly delousing patients on admission to home hospitals as well as of revising the diagnosis by bacteriological examination.

Gerstl, of the German Children's Clinic at the Prague Foundling Hospital, records a case of relapsing fever in an infant aged 8 days, in whom the disease ran a fairly typical course and was apparently cured by an intra-gluteal injection of 0.02 gramme neosalvarsan. The mother, who had an attack of relapsing fever at the time of her confinement, had recently come from Roumania, where her mother and grandmother were similarly affected, so that four generations were simultaneously suffering from the disease. As the child was separated from its mother immediately after birth, infection must either have taken place *intra partum* or have been transmitted by lice, but the former hypothesis is the most probable. Gerstl has not been able to find another example on record of relapsing fever in the new-born.

Strominger, of Bucharest, whose observations on the urinary complications of typhus have recently been mentioned, states that relapsing fever, like typhus, fairly frequently affects the kidney and more frequently the bladder, as he has seen about thirty cases of vesical disorder in patients dating from six weeks to two or three months after the fever.

Monziols and Collignon found that in the great majority of their cases of relapsing fever a syndrome of *acute suprarenal insufficiency* developed during the

twelve hours following the injection of novarsenobenzol, characterized by nausea and vomiting, profound asthenia, fall of blood-pressure, with discoloration of the skin and mucous membranes and the appearance of Sergeant's white line. They attribute the condition to the sudden destruction of the spirilla by the arsenical treatment, whereby a large quantity of toxin is set free and renders the antitoxic function of the suprarenals insufficient. Since they have systematically injected one milligramme of adrenalin into every patient who has been given "914," they had never met with the syndrome. One patient who was not treated with adrenalin developed left hemiparesis and violent delirium at the same time as the suprarenal syndrome. The cerebrospinal fluid was normal, and there was no history of syphilis. Three injections of one milligramme of adrenalin were followed by considerable improvement the same evening, and the next day the paresis disappeared.

According to Löwy, who records a relatively mild epidemic of 119 cases in Belgrade in 1918, two of which developed paralysis of the circumflex nerve, *nervous complications* in relapsing fever are rare, transient facial palsy, hæmorrhagic pachymeningitis, and apoplexy being the only ones given in the text-books. Koch and Lippmann have recently reported a case in which loss of consciousness was accompanied by abducens and facial paralysis, flaccid paralysis of the right arm, and bilateral Babinski's sign. The palsies all disappeared in a few days, being probably due to vascular obstruction caused by the spirilla or to inflammatory changes in the brain substance. Walko has recorded five cases with meningeal symptoms which ran a similar course. In one of Löwy's cases the increased reflexes and ankle clonus pointed to spinal involvement, while in the other the absence of knee-jerks indicated a peripheral process.

It may be noted that one of Newcomb's sixty-six cases developed facial paralysis, but he was unable to determine whether this was a mere coincidence or not.

Manson and Thornton also found that nervous lesions were extremely uncommon, as in a series of about 1,500 cases of East African relapsing fever observed in 1917 and 1918, not more than $\frac{1}{4}$ per cent showed any sign of nerve involvement. Nervous complications in their experience always occurred late in the disease, seldom earlier than the sixth week after the disease had been diagnosed as relapsing fever. The lesions were of a transient nature clearing up in a time proportionate to the severity of the case and the nature and extent of the nervous tissue involved. The cases were classified into (1) those showing gross central nervous lesions, such as aphasia, complete facial paralysis, and hemiplegia, and (2) cases showing involvement of one or more cranial or spinal nerves.

Trantas records his observations on the *ocular complications* of relapsing fever in the military hospitals of Athens. (1) Conjunctival lesions. During the fever there was frequently congestion of the palpebral and bulbar conjunctiva. In four out of fifty cases the conjunctiva was markedly icteric during the fever and for some days later. (2) Corneal lesions. Twenty-three out of fifty cases, or forty-six per cent, showed superficial transient lesions almost always situated in the upper half of the cornea on one or both sides analogous to the renal lesions, as shown by albuminuria and the presence of granular casts which are so frequent and transient in relapsing fever. (3) Iridocyclitis with or without ophthalmoscopic lesions. (4) Ophthalmoscopic lesions such as retinal hæmorrhage, chorioretinitis, and opacity of the vitreous apart from iridocyclitis.

Manson and Thornton found that iritis and iridocyclitis were very frequent in East African relapsing fever, both among Europeans and natives. The complication might occur at any period of the disease, but was unusual in the latter stages when the relapses had come to an end. Though the condition was usually bilateral, one eye as a rule was affected much more seriously than the other.

According to Costiniu, of Bucharest, the *aural complications* of relapsing fever assume almost the same form as in typhus, but are less frequent, and recovery after operation is more rapid. The *laryngeal complications* of relapsing fever are much rarer than in typhus. In one patient who had relapsing fever and then typhus a polypoid growth on the vocal cord was found and successfully removed. Histological examination proved that it was of inflammatory nature. In another case an endolaryngeal phlegmon was opened and cured. Costiniu also saw two cases complicated by quinsy, in the pus from which Obermeyer's spirillum was found.

During a severe epidemic of relapsing fever in the winter of 1918-19 in Teheran, Post saw at least half a dozen cases of *costal caries* and heard of many more. The history given was of pain and swelling over the front of the chest during the illness, not subsiding during convalescence, with abscess formation a few weeks later. The upper and middle cartilages were attacked from the third to the eighth. The course of the infection was afebrile and marked by great indolence, resembling similar infection following typhoid. Post himself developed an abscess over the fifth right costosternal articulation, for which several operations were required, parts of the fifth, sixth, and seventh cartilages and ribs being removed. The site of infection, viz., the posterior aspect of the costal cartilages, and the low resistance of the cartilages themselves, are regarded by Post as accounting for the extensive burrowing which demands radical resection of the overlying tissues.

Treatment.—From observations in the outbreak in Mesopotamia, Newcomb concluded that 0.45 gramme was the best dose of neosalvarsan for the treatment of relapsing fever. In 30 cases 0.8 gramme was given, and in 8 of these subsequent relapses necessitated a further dose of 0.3 gramme, and in 1 case two further doses, whereas in 20 cases which had 0.45 gramme in the first place no relapse occurred.

Del Prado confirms the remarkable efficiency of neosalvarsan in the treatment of relapsing fever, only two of the 362 cases under his care failing to show a complete cure under it, and these two cases left the hospital too early. He never had occasion to repeat the injection of 35 or 45 centigrammes of neosalvarsan in 10 cubic centimetres of distilled water.

Peyre states that during the epidemic of relapsing fever in Roumania in the winter of 1916-17, when the supply of neosalvarsan ran out, intravenous injections of a solution of cacodylate of soda generally stopped any further attacks, though not so rapidly as neosalvarsan.

Pathology and Bacteriology: L'encefalite epidemica a Roma. (Epidemic Encephalitis in Rome.) G. Pecori. *Ann. d'ig.*, 1921, 32.—Interesting epidemiological considerations on lethargic encephalitis in Rome are contributed by Pecori. A few cases were observed during the first months of 1919, but this small epidemic passed almost unobserved since only about a dozen people were apparently affected. A few sporadic cases also occurred, probably during the summer of 1919, but a true epidemic only began in November of the same year and lasted till the end of February of 1920, though sporadic cases continued to be observed in the following months. It is worth noting that this epidemic was preceded and accompanied by a relatively great number of cases of hiccough. This generally lasted three or four days and was accompanied, in a limited number of instances, by slight fever and gastric disturbances. In most cases, recovery promptly followed; in some it gave place to a typical form of lethargic encephalitis. The author is, therefore, of the opinion that epidemic hiccough is nothing else than a mild form of the malady. The total number of ascertained cases observed in Rome between November, 1919 and August, 1920 was 338; of these 158 were male and 180 female. The maximum of incidence and mortality in regard to age was between 21 and 40. The greatest mortality was observed

amongst workmen and Jews. Most cases had been previously affected by influenza; but the author attaches little importance to this observation because only a few people were not affected by influenza in Rome during the winter of 1913-19, and all one can safely say, from an epidemiological point of view, is that influenza does not confer any immunity against lethargic encephalitis. The malady prevailed in the poorer quarters of the town which in Rome are also most crowded and often dirty. As to the clinical types of the disease the stuporous and hyperkinetic ones were most frequent. The greatest mortality was observed in the erethistic, stuporous, and mixed forms. As to the contagiousness, the observations of Pecori are similar to those made in other countries, and he comes to the conclusion that propagation of the malady from one to another individual can be explained in most cases only by assuming the existence of healthy or slightly affected carriers.

Sul valore etiologico del *Proteus vulgaris* nel cholera infantum. (On *Proteus vulgaris* as an Ætiological Factor of Cholera Infantum.) G. Pupilli. *Ann. d'ig.*, 1920, 30, 763.—Experiments were made on very young laboratory animals such as rabbits, guinea-pigs, and puppies to which varying doses of pure cultures of *P. vulgaris* were administered *per os*. The results did not confirm those obtained by Metchnikoff in similar experimental conditions, since in the author's opinion the morbid changes thus caused have very little likeness to the symptomatology of cholera infantum. The same happened when the pathogenic action of *P. vulgaris* was favoured by an abnormal state of the enteric tract experimentally caused by various means. Small laboratory animals and particularly very young rabbits may die after the ingestion of large, and sometimes even small doses of proteus cultures, but this seems to be due to a toxic action of the germ, and does not prove that it is the direct ætiological factor of cholera infantum. However, *P. vulgaris* may play a certain rôle in the pathogenesis of the disease as in any other enteric affection favourable to its development.

Reviews.

THE STORY OF THE HORTON (COUNTY OF LONDON) WAR HOSPITAL, EPSOM.
By Lieutenant-Colonel J. R. Lord, C.B.E., M.D., Officer Commanding.
London: W. Heinemann (Medical Books), Ltd., 1921. Pp. 264.

This is an interesting description of the work involved in the successful adaptation of a large asylum to the requirements of a war hospital on a big scale, ready to receive sick and wounded direct from overseas. It tells of many difficulties which by tact and careful handling were gradually overcome.

In Part I a detailed description of the administrative side of the picture is given in diary form. While in Part II are recorded particulars of the various special sections with their staffs and the numbers treated.

Although there is little of professional interest in the book it is well worth reading and it will be especially appreciated by those who were connected with this important war hospital. A. D. S.

THE LETHAL WAR GASES—PHYSIOLOGY AND EXPERIMENTAL TREATMENT. By Frank P. Underhill, Ph.D. Yale University Press, 1920.

This monograph is more in the nature of a report of investigations than a complete discussion of the many problems involved in the title given to it.

The investigations were undertaken by a section of the Medical Division of the

Chemical Warfare Service of the U.S.A. Attention was confined to the three lung-irritant gases, chlorine, phosgene and chlorpicrin.

Dogs were in most cases the animals used for experiments. Though successful results in treatment of gassed animals were obtained too late in the war to be applied to gassed men in the field, observation of the condition of the latter led the author to believe that his results would have been equally successful had a trial, proposed just before the time of the signing of the Armistice, been carried out.

One of the first problems tackled was an accurate determination of the concentrations of the various gases to which animals were exposed—a problem which presents many difficulties. The technique devised consists in principle in “passing a mixture of gas and air through an airtight chamber containing the experimental animal for a definite period at a determined rate, checking the mixture by frequent analysis of samples taken from the chamber.” By this means valuable information was collected as to the toxicity and lethal concentrations of the substances examined.

The effects of these were studied on respiration, pulse and temperature and on metabolism as indicated by examination of urine. As regards metabolism, high and low concentrations of gas produced somewhat different effects. Thus, with high concentrations of chlorine, there were increased nitrogen output, acidosis (as indicated by increased acidity, augmented excretion of ammonia and phosphates and “organic” acid), and increased elimination of chlorides—chlorides were retained for the first twenty-four hours, after which elimination was augmented. With low concentrations a milder degree of acidosis was found and there was no retention of chlorides in the first twenty-four hours.

Phosgene gas poisoning gave a somewhat different picture. The effects of repeated exposure to gas were also studied.

Results failed to show any increased susceptibility in dogs to chlorine, but with phosgene experiments, which were few in number, tended to show an increased susceptibility, the effects of chlorpicrin in this respect were not tried.

Very extensive investigations were made into the changes in blood concentration after exposure to gas. The most numerous observations were made with phosgene and the results obtained showed that with this gas the changes are in three stages:—

Stage I.—The blood contains less solid matters than normally. This stage lasts several hours.

Stage II.—Concentration begins and rapidly assumes a maximum.

Stage III.—A gradual return to normal.

Characteristic differences in length and degree of stages were observed with different concentrations.

The concentration was determined either by estimation of the total solids or of the hæmoglobin. The latter method is less cumbersome and more accurate.

With chlorine poisoning the stage of preliminary dilution is either absent or very slight and the stage of concentration develops rapidly and obtains a high maximum.

With chlorpicrin the stage of dilution is usually absent. The author regards the observation of these stages as of great importance from the point of view of treatment.

Observations were also made on the development of pulmonary œdema in its true relations and its correlation with blood concentration. The association of this change with chloride and fluid exchange in the tissues and its relation to vascular permeability was also examined.

The author concludes that “the development of œdema as a result of the action of lethal war gases is associated with well-defined changes in the fluid and

salt content of the blood and tissues without an apparent increase in the permeability of the blood-vessels. Fluid and salt probably pass from the tissues to the blood in an attempt to compensate the latter for its loss in those constituents which mobilize in the lungs, resulting in œdema. Later, if œdema subsides there may be re-absorption of fluid and salt, a portion being re-distributed in the tissues, the remainder being excreted through the kidneys.

Further observations were made on the changes in oxygen content of the blood and the production of acidosis.

As a result of his investigations as outlined above, the author gives an interpretation of the sequence of events in lung-irritant gas poisoning and discusses the cause of death. He regards blood concentration as the immediate cause, while accepting that œdema is indirectly responsible. His whole aim in treatment is therefore to prevent blood concentration or restore it to normal level. With this end in view he investigated the effects of venesection and the intravenous injection of saline and other substances and of administration of oxygen.

It must be remembered as pointed out above that his experiments were tried on dogs and that few observations were made on human beings. His conclusions are based on the study of 300 dogs gassed at the standard lethal concentration where intensive changes induced are such as to put therapeutic measures to a most rigorous test.

He found with chlorine poisoning that the following measures were distinctly beneficial: (a) bleeding, infusion with isotonic saline in volume equal to the blood withdrawn; administration of sodium bicarbonate by a stomach sound; (b) bleeding and infusion of Na_2HPO_4 solution; (c) bleeding alone. Other less beneficial and distinctly harmful methods are tabulated, as are the results obtained with similar measures in phosgene and chlorpicrin poisoning.

The author's conclusions as regards oxygen administration differ to some extent from the observations made on goats at Porton and from clinical experience in France. He holds that "the method of treatment involving venesection, infusion and oxygen administration is indicated for the re-establishment of normal conditions of the respiratory functions of the blood in an animal gassed with phosgene. It should be emphasized that oxygen administration alone is entirely inadequate to combat the effects of phosgene poisoning, inasmuch as this procedure does not eliminate the primary cause, namely, concentration of the blood. When treatment succeeds in restoring blood concentration to a more nearly normal level, oxygen administration is of decided benefit."

The experimental data obtained in the investigations are given in detail in the text and in appendices.

The monograph is a most valuable contribution to the literature of gas poisoning, but is of greater interest to the research workers than to the clinician.

THERAPEUTIC IMMUNIZATION IN ASYLUM AND GENERAL PRACTICE. By W. Ford Robertson, M.D. Edinburgh: E. and S. Livingstone, 1921. Pp. vii + 278. Price 15s. net.

There can be no doubt that vaccine therapy has in some quarters fallen into great disrepute. The reasons for this are not far to seek and the author does a service by clearly enunciating them.

Undoubtedly the most important reason is the general lack of knowledge of the principles underlying vaccine therapy, leading to indiscriminate use of vaccines.

It is essential, therefore, that steps should be taken to dispel the general ignorance. It is pointed out that systematic instruction in therapeutic immunization is not given in medical schools; but it is doubtful if the time has yet come to follow up this suggestion, though even now some schools are doing very useful propaganda, as the science and practice of vaccine therapy can hardly

be said to be beyond the stage of experiment, and divergence of opinion on many points even amongst those who are well qualified to speak, is still considerable.

If it were realized more generally that vaccine therapy is not a "rule of thumb" matter, but in each individual case is of the nature of an experiment which must be watched and studied from day to day, we should hear less said against it.

The author's view is that "It has probably been more on account of the results of gross overdosage than from the use of wrong vaccines (common as this has been) that therapeutic immunization has fallen into such disrepute among specialists and practitioners," and he is not far wrong.

After discussing the theories of immunity and therapeutic immunization the author proceeds to give in detail the methods employed in preparing vaccines and here he joins issue with those who still use counting and opacity methods of standardization in preference to gravimetric.

The two most important chapters of the book deal with bacterial infections amenable to therapeutic immunization and the treatment of infective diseases.

In these chapters are collected and embodied the experience of many other workers and hence there is presented in the main a more or less orthodox view of the subject.

As is well known, the author attributes to the group of diphtheroid bacilli an important rôle in human pathology.

It is generally agreed that diphtheroid infections play an important part in some diseases, e.g., nasal catarrh, but that diphtheroids may produce a neurotoxin capable of causing symptoms of neurasthenia, exophthalmic goitre, disseminated sclerosis, tabes dorsalis and various mental disorders, is rather a big thesis to put forward without the backing of much experimental evidence. At the same time a case is made out for research on this group of organisms and it is surprising that the author in view of his expressed opinions does not appear to have made a biological study of the group.

From the very widespread distribution of diphtheroids, and if the author's views are correct, it is obvious that only certain members of the group have pathogenic properties, and some attempt should be made to find means of identifying them and placing them in their proper category.

J. C. K.

Notices.

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Original Communications.

PRELIMINARY EXPERIMENTS WITH A VIEW TO
THE PREPARATION OF A NON-TOXIC
DYSENTERY VACCINE.

BY MAJOR F. R. COPPINGER,

Royal Army Medical Corps,

AND

CAPTAIN R. C. ROBERTSON,

*(Late) Royal Army Medical Corps**(Pathological Department, Royal Army Medical College).*

A COMPARISON between the incidence of the enteric group of infections and bacillary dysentery during the recent war evidences in a striking manner the effects of prophylactic vaccination against the former group of diseases. The occurrence of enteric infections almost disappeared, and the severity of those cases which did occur was much diminished. On the other hand, bacillary dysentery was widespread on every front, and in the closing years of the campaign constituted a serious cause of wastage of man power. In certain instances attempts were made to immunize small numbers of men by means of prophylactic inoculation, but very little success attended any of the measures employed.

This failure to produce immunity may have been in part due to the fact that bacillary dysentery is not, as a rule, associated with a general blood infection, as in the case of the enteric group of diseases, but the chief difficulty was the impossibility of inoculating sufficiently large doses of vaccine owing to the severity of the reactions produced.

It is evident, therefore, that if any method can be devised which will diminish the toxic properties of the bacillus without affecting its antigenic

value as a vaccine, considerable advance will be made in the possibilities of vaccine prophylaxis.

In the past various methods have been suggested towards this end, and of these sensitized and sero-vaccines have probably found most favour.

PREVIOUS METHODS OF PREPARING VACCINES FOR BACILLARY DYSENTERY.

Sensitized Vaccines.—Sensitized vaccines, prepared in the ordinary manner by treating suspensions of the bacilli with their homologous sera, and, after incubating for some time, removing the serum by means of the centrifuge, have been employed to a considerable extent, but not with much success, since they remained toxic and produced severe reactions.

Sero-vaccines.—The Japanese method consisted in injecting an equal bulk of anti-serum at the same time as an ordinary vaccine prepared from dysentery bacilli. The toxic effects in this case were neutralized, but it appeared that the antigenic properties were also greatly diminished.

Gibson [1] working on the same lines produced a sero-vaccine composed of a mixture of anti-serum with ordinary dysentery vaccine, but he attempted to remove the anti-bacterial substance from the serum prior to injection, while leaving the anti-toxic substance unaffected. His method for removing the anti-bacterial substance was to absorb the serum with dysentery bacilli, and then remove the organisms by passing the treated serum through a filter candle. As far as can be ascertained, however, from a limited trial of this vaccine the immunity produced was not sufficient to warrant its use on a large scale.

Lipo-vaccines.—Lipo-vaccines, which consist of a suspension of the organisms in some oily substance, have also been employed in prophylactic inoculation for dysentery; the basic principle underlying this method being that the oily substance delays absorption and thus prevents the injurious effects of the toxins on the tissues. Early in 1918 Whitmore and Fennel [2] of the U.S. Army prepared a lipo-vaccine for dysentery on a large scale by growing the bacteria in Kolle flasks, removing the growth with a vacuum scraper, freezing and drying in vacuo, and emulsifying in lanolin and oil by grinding in a ball mill. The oils were sterilized by steam at fifteen pounds for fifteen minutes, by heating to 90° C. for ten hours in a water bath or by mixing with potassium iodide. They gave very large doses, up to 3,000 million Shiga, 3,200 million "Y," and 2,200 million Flexner, without marked local or general reaction, and claimed to have demonstrated the presence of agglutinins, precipitins, and bacteriolysins in the blood of the inoculated animals and men. The difficulty, however, of preparation, especially in the sterilization of the oils, was so great that this vaccine was abandoned by the U.S. Army shortly after the armistice.

Chemically-treated Vaccines.—Chemically-treated vaccines are a comparatively new departure in vaccine therapy, and, judging by the results

already claimed by various authors, there appears to be every prospect of their being used with success in the future.

Very little work, however, has been carried out along these lines in the case of dysentery bacilli, although they form one of the most important groups for which a non-toxic antigen is required.

In 1916, Dean and Adamson [3] found that by suspending Shiga bacilli in dilute eusol solution, the toxicity of the organism was reduced, but subsequent experience proved that the irritant effects of the inoculation were not eliminated to a degree which would permit of its general use as a vaccine. Especially was this the case when the vaccine was stored for some time after preparation.

More recently Jötten [4] claims to have produced a non-toxic antigen for Shiga bacilli by treating a suspension of the organisms with dilute antiformin and subsequently neutralizing and dechlorinating the mixture. It was found, however, on repeating his experiments, that although the toxicity was undoubtedly diminished, it was not reduced to the degree claimed in his paper. It is possible, of course, that this discrepancy in findings may have been partially due to a difference in toxicity of the strains of organisms used in each case.

As far as we are aware the above have been the only attempts at reducing the toxicity of *Bacillus shiga* by chemical means, and it appeared desirable to carry out further investigations on these lines.

The results claimed by Thomson [5] in the "detoxication" of various organisms by treatment with alkali suggested the application of a somewhat similar procedure in relation to *B. shiga*. Thomson found that many organisms rapidly dissolved in the presence of N/10 or N/20 sodium hydroxide, while others were comparatively insoluble even in much stronger solutions of the alkali. Many of the latter, however, showed evidence of solution in 10 per cent. NaOH, and all dissolved under prolonged treatment with antiformin at 37°C. If these alkaline solutions of bacteria were now neutralized with an excess of acid, a precipitate formed which, on being separated and washed, proved to be non-toxic, while the neutralized supernatant fluid remained toxic and caused similar reactions to that following inoculation of the untreated bacilli. It was further claimed that the non-toxic precipitate retained the antigenic properties of the organism, and produced on inoculation into animals a definite immunity without giving rise to the usual local and general reactions. Much larger doses could, therefore, be tolerated than in the case of the ordinary vaccine, and it was claimed that the immunity produced was proportionally much increased.

This, in short, was the theory of Thomson's original "detoxicated" vaccine, and although he has recently further developed the principle of splitting up the organism into its toxic and antigenic portions, the above remains the basis of all his subsequent work.

PRESENT WORK.

The experiments described in this paper refer only to the Shiga bacillus, but as this organism is by far the most toxic of the dysentery group, it is considered that, if its toxicity can be reduced without affecting its antigenic properties, little difficulty would be experienced with the other organisms of the group.

Preliminary attempts to dissolve suspensions of Shiga bacilli with decinormal and normal sodium hydroxide were not successful, and even stronger solutions up to about twenty per cent failed to break up the organisms. It was noted, however, that after contact with normal sodium hydroxide for one or two hours at 37° C. the bacilli appeared swollen and distorted in shape.

When a suspension thus treated was neutralized with normal hydrochloric acid it became more opaque, presumably owing to the formation of a very fine precipitate or colloidal suspension of some dissolved constituent of the bacilli. It was found, however, impossible to obtain any quantity of the residue on centrifugalization, the bulk of the swollen bacilli even remaining in suspension.

Attempts were now made by various methods to obtain this residue and it was found that the suspension, if treated with an excess of absolute alcohol, yielded a light flocculent precipitate which gradually subsided to the bottom of the flask, and could more rapidly be brought down by means of a centrifuge. This precipitate, on being washed and dried, formed a white powder, which on microscopical examination appeared to be formed of partially broken up and macerated bacilli.

Portions of this powder equivalent in weight to 20 million, 200 million, and 400 million unaltered Shiga bacilli were injected intravenously into rabbits. No lethal effects were produced and toxic symptoms did not appear. A low agglutination titre (1/100) was obtained in one animal after a course of three inoculations of about the equivalent in weight to 200 million untreated Shiga bacilli given at weekly intervals. This animal was then found to be protected against an inoculation of 200 million untreated bacilli, which, as will be seen later, represents approximately ten times the fatal dose for an animal of the same weight.

Steps were now taken to ascertain the minimum lethal dose of the strain of Shiga bacilli used in all these experiments so as to be able to form a more accurate estimation of the reduction in toxicity caused by the action of the alkali. A suspension of the bacilli was accordingly dried *in vacuo*, and the residue ground to a fine powder. Various quantities of this powder suspended in normal saline solution were injected intravenously into rabbits of approximately the same weight, and it was found that 0.01 of a milligramme (equivalent to about twenty million bacilli) was just sufficient to kill a rabbit weighing 1,000 grammes in three days. This quantity was accordingly counted as the minimum lethal dose, though it was found later

that rabbits vary very considerably in their resistance, and that occasionally they could survive a slightly larger dose. It was never found, however, that even a large rabbit could resist more than 0.05 of a milligramme of dried Shiga bacilli injected intravenously unless it had been immunized by previous inoculation.

Similarly it was found that one milligramme of dried Shiga bacilli injected *subcutaneously* was just sufficient to kill a rabbit weighing 1,150 grammes in three days. This large dose was, of course, necessary owing to the slow absorption from the subcutaneous tissues.

In these experiments it was found that the rabbits died with paralytic symptoms, and practically no diarrhoea, and no post-mortem lesions of the intestines beyond a slight congestion could be demonstrated. Intestinal lesions, however, did occur in cases of delayed death following partial immunization.

The above method for reducing the toxicity of Shiga bacilli by treating them with NaOH, neutralizing with HCl, and precipitating with alcohol, appeared fairly satisfactory. The amount of alcohol, however, required for the precipitation was very considerable and it was therefore considered desirable to try some more economical method of preparation.

On attempting to precipitate with ammonium sulphate it was found that almost complete saturation produced a similar reaction to that of the alcohol, the precipitate, however, being heavier and sedimentation more rapid.

In order, therefore, to treat the organism with alkali and produce a strong solution of ammonium sulphate on neutralization, a new method was adopted. To a thick emulsion of Shiga bacilli an equal bulk of liquor ammoniæ fortis (B.P.) was added. The mixture was allowed to stand in the incubator at 37°C. over night, and neutralization was then effected by means of twenty per cent. sulphuric acid, which, combining with the ammonia, formed ammonium sulphate. No precipitation occurred until the neutral point was reached, when a heavy precipitate immediately formed which rapidly subsided to the bottom of the flask leaving a clear supernatant fluid.

On separating and washing the precipitate it was found to be composed of bacilli which were somewhat swollen and altered in shape, but still quite discrete and distinct.

Inoculation into rabbits showed that these altered bacilli were relatively non-toxic, but retained their antigenic properties.

A series of experiments was now commenced with a view to testing the antigenic power of the altered bacilli and determining the most suitable doses for immunizing purposes. The immunizing effects were estimated by injecting toxic Shiga bacilli into rabbits previously inoculated with the new antigen, and judging from the results the degree of protection which had been conferred. In the absence of symptoms the condition of the rabbits was judged by the weight, an accurate daily chart of which was kept in every case.

248 *The Preparation of a Non-toxic Dysentery Vaccine*

Little reliance was placed on agglutinin production in animals thus immunized, as it was not considered to give a true estimate of the degree of protection.

The immunizing doses were estimated by opacity, using Brown's barium sulphate tubes. In this connexion it may be noted that before making up the final emulsion, the altered bacilli were not, as a rule, completely dried, as it was found difficult to produce an even emulsion from the dry powder. A table was, however, prepared, showing the weight of dried antigen corresponding to each opacity tube.

A series of ten rabbits was inoculated, five subcutaneously and five intravenously, with ammonia-treated bacilli. The doses given and the results obtained are shown in Table I.

TABLE I.

Rabbits inoculated	Doses of treated Shiga bacilli, in milligrammes, at seven-day intervals			Agglutination titre of serum 24th day	Lethal doses of toxic Shiga bacilli 24th day, intravenously	Result
<i>Subcutaneously—</i>						
Rabbit 346 ..	0.5	1.0	5.0	1 in 120 ..	10 M.L.D. ..	Survived. No symptoms beyond a slight temporary loss in weight
Rabbit 347 ..	0.5	1.0	5.0	1 in 30 ..	20 M.L.D. ..	" "
Rabbit 348 ..	1.0	2.0	7.5	1 in 120 ..	10 M.L.D. ..	" "
Rabbit 349 ..	1.0	2.5	10.0	1 in 60 ..	20 M.L.D. ..	" "
Rabbit 350 ..	2.0	5.0	10.0	1 in 130 ..	20 M.L.D. ..	" "
<i>Intravenously—</i>						
Rabbit 351 ..	0.1	0.2	0.5	1 in 500..	10 M.L.D. ..	Survived. No symptoms nor loss in weight
Rabbit 352 ..	0.1	0.5	1.0	1 in 1,000..	20 M.L.D. ..	" "
Rabbit 353 ..	0.25	..	..	..	..	Died fifth day after first inoculation
Rabbit 354 ..	0.5	..	..	..	..	Died third day after first inoculation
Rabbit 355 ..	1.0	..	..	..	..	Died second day after first inoculation

All the rabbits inoculated subcutaneously survived, and suffered from no obvious reactions, either local or general, though in each case a distinct drop in weight occurred for a few days after the lethal test dose, which was subsequently injected intravenously.

Three of the series injected intravenously died after the first inoculation which was apparently too large. But the two which had received 0.1 of a milligramme survived, and afterwards received larger doses, without showing any ill-effects. Moreover, the protection conferred was greater than in the case of the subcutaneously-injected rabbits, as was judged by the fact that the injection of the lethal test dose produced no loss in weight.

Antitoxic Power of the Serum of Immunized Animals.—An attempt was now made to test the antitoxic effect of serum obtained from the seven

rabbits surviving from the above experiments. Serum obtained from each of the rabbits was pooled, and one cubic centimetre of the pooled serum injected into each of three normal rabbits along with 0·8, 0·4, and 0·1 of a milligramme of unaltered Shiga bacilli respectively. The first two rabbits died, but the animal which had received 0·1 of a milligramme (10 M.L.D.) survived, showing that the serum had acquired some degree of antitoxic power. Table II shows the result of this experiment.

TABLE II.

Source of serum employed				Amount of serum mixed with the toxin	Weight of dried toxic Shiga bacilli injected	Result
(Control)	..	..	..	nil	0·1 mgrm.	Died 2nd day
Normal rabbit	..	..	..	1 c.c.	0·1 "	" 3rd "
Inoculated rabbits (serum pooled)	..	..	..	1 "	0·8 "	" next "
"	"	"	..	1 "	0·4 "	" 3rd "
"	"	"	..	1 "	0·1 "	Survived

Human Experiments.—Human experiments on any large scale have not yet been carried out, but one of us received injections of 0·03, 0·075, 0·15, and 0·3 of a milligramme of treated Shiga bacilli (approximately equal to 60, 150, 300, and 600 millions) without any reaction beyond a slight local tenderness and induration, which, in the case of the largest dose, persisted some days.

CONCLUSIONS.

The experiments described appear to prove that it is possible to reduce the toxicity of Shiga bacilli by chemical means without seriously reducing their antigenic properties. In the method employed this chemical action does not involve the complete breaking down and solution of the bacilli as in Thomson's detoxicated vaccines.

It is difficult to determine the exact action of the alkali on the organism, whether it removes some toxic constituent from the bacilli, or else changes the composition of the toxin, possibly reducing it to the toxoid state. The latter appears somewhat more probable as the supernatant fluid remaining after the precipitation of the bacilli was found to be non-toxic to animals.

Whatever may be the explanation of the action of the alkali, it would appear to be evident that the bacilli treated by this method are relatively non-toxic and may safely be used for commencing immunization in animals. The importance of this fact is obvious when it is remembered that there has always been a considerable mortality among laboratory animals during the early stages of immunization with unaltered Shiga bacilli.

Whether vaccines prepared on the same lines would be satisfactory for the prophylactic or therapeutic treatment of bacillary dysentery in human beings has yet to be proved.

250 *The Preparation of a Non-toxic Dysentery Vaccine*

Investigations on these lines are still in progress.

In conclusion, we wish to express our very grateful thanks to Colonel S. L. Cummins, C.B., C.M.G., A.M.S., Lieutenant-Colonel H. Marrian Perry, O.B.E., R.A.M.C., and the other members of the Advisory Committee on Pathology for their very valuable assistance and advice.

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MALARIA IN MACEDONIA, 1915-1919.

PART IV.

CHEMICAL INVESTIGATIONS ON THE EXCRETION OF
QUININE BY SOLDIERS IN MACEDONIA.

BY CAPTAIN T. S. HELE.

Royal Army Medical Corps (T.F.)

Work at the Malaria Inquiry Unit, Salonica, commenced in March, 1918, and was continued till the end of the year. It was intended to carry out investigations on the fate of quinine in the organism in health and in disease, and for this purpose apparatus, etc., was ordered from England. The apparatus, however, did not reach Salonica until the autumn, when the work of the unit was practically stopped by the outbreak of influenza, and by the movement of troops.

During the summer Professor Ramsden kindly supplied information about the methods for the estimation of quinine in blood, and the necessary apparatus was ultimately obtained, a few estimations being carried out before the work of the unit came to an end.

The limited observations recorded below on the excretion of quinine by men suffering from malaria during the height of a Macedonian summer, may perhaps be usefully compared with the fuller work carried on in London and Liverpool.

SECTION 1.—LABORATORY METHODS.

For the detection of quinine in urine and fæces, the tests employed were Tanret's test, the thalleioquinone test, and fluorescence in acid solution. The tests were carried out on final products obtained by extraction from the material. For urine, Klein's picric acid method of separation was used, and for fæces a combination of the Stas Otto and the picric acid methods. The fæces of all cases were examined for quinine, but never more than traces were discovered.

For the estimation of quinine in the urine, Klein's picric acid method, as modified by Captain Ferrey, R.A.M.C., T.F., was employed, as it had already proved satisfactory in his hands, and the necessary reagents were in the command. The unit possessed at this time only two small separating funnels too small for the extraction of any large volume of fluid, so that a precipitation method for the separation of the quinine was a necessity.

The Picric Acid Method of Estimating Quinine.—Two hundred cubic centimetres of urine are acidified with a few drops of dilute sulphuric acid

and boiled. One to 1.5 grammes of dry picric acid are added to the hot mixture and stirred in. The whole is allowed to stand at least for one hour, with occasional stirring. The liquid is then filtered through a filter paper of diameter not larger than 4½ inches, till the filtrate comes through clear. The filtrate must give no precipitate with a saturated aqueous solution of picric acid. The precipitate and filter paper are transferred without washing to an Erlenmeyer flask, fifty cubic centimetres of three per cent caustic soda added and the whole heated on the water-bath for half an hour with occasional shaking of the contents. The flask is cooled, and the contents are transferred to a separating funnel, and extracted three times with fifty cubic centimetres of chloroform. The chloroform extract is collected in a flask, and the chloroform is distilled off. The residue is redissolved in dilute sulphuric acid. The solution is transferred to a separating funnel, is extracted twice with chloroform to remove pigment, is then rendered alkaline with three per cent caustic soda and shaken out three times with chloroform. The three chloroform extracts are run into a tared flask, the chloroform is distilled off, the flask dried at 120° C. to constant weight and weighed. The residue is quinine, together with any other alkaloids present in the urine.

The picric acid method has been attacked on two grounds :—

(1) The final product is said to be very impure (Ramsden and Lipkin).

(2) The results are too low (— 1.24 per cent to — 3.91 per cent Nierenstein).

Neither of these criticisms has been sufficiently substantiated to render the results obtained by it so unreliable as to vitiate its usefulness. In a hot climate it is certainly preferable to extract with chloroform whatever method is used. This method has two advantages :—

1) No limits need be set to the quantity of urine used. It was usual in the observations recorded below to use from a quarter to a half of the total twenty-four hours' urine, so that any error in estimation would not be unduly magnified.

(2) The suspension, obtained by heating the picric acid precipitate with caustic soda, can be stored for some time without deterioration. This is an advantage when a series of observations are to be made, and apparatus is limited.

In estimating quinine in the urine of blackwater fever cases it is first necessary to remove proteins, at any rate partially, before precipitating with picric acid, as otherwise during extraction the chloroform layer will not separate. With ordinary urines no difficulty was experienced in the separation of chloroform at the room temperatures (80° F. to 100° F.), at which most of the work was carried out.

In this series, with one exception, the error falls within the limits given by Nierenstein. Much importance cannot be placed on the Gordin titration figures, for as Ramsden and Lipkin have pointed out an error of 0.1 cubic centimetre in the final titration gives an error of at least 0.8 milli-

gramme in the result. In these experiments methyl red was used as indicator in the place of methyl orange, in order to get a sharper end point.

ESTIMATION OF QUININE IN ARTIFICIALLY PREPARED QUININE-CONTAINING URINES.

Vol. urine taken c.c.	Quinine added, mgrm.	Quinine found, mgrm.	Quinine in final product as determined by Gordin's titration method (Ramsden and Lipkin), mgrm.
200	100	98.2	97.2
200	100	97.0	95.6
200	50	49.5	50.0
200	50	49.8	50.0
200	20	19.5	19.0
300	19	18.0	17.8
400	40	39.6	40.0

Effect of Storage of Picric Acid Product, previous to final Extraction.—Urines were taken at random for experiment, no particular precautions were observed. Duplicate sets were taken for analysis. In one set the estimations were completed at once. In the other the picric acid precipitate was heated with caustic soda and kept for four months during the height of the summer.

Urine	Volume, c.c.	Quinine estimated at once, mgrm.	Quinine estimated after four months, mgrm.	Error, per cent
1	300	117.5	111.0	5.5
2	300	80.0	76.2	4.8
3	200	24.3	24.2	Nil
4	500	70.0	70.6	"
5	300	33.0	31.0	6.0
6	300	47.0	46.0	2.1
7	100	64.0	62.4	2.5

In actual practice urines so treated were not stored for longer than fourteen days before extraction.

SECTION 2.—THE EXCRETION OF QUININE IN HEALTH.

Observations were made on a healthy man to serve as a standard of comparison for the estimations made in cases of malaria. The subject, who had been in Macedonia for two years, was 36 years old, weighed ninety kilograms, and had suffered from no illness for many years. Malaria parasites have never been detected in the blood, though examination had been frequently made. He had taken no quinine for twelve months previous to the experiment.

254 *The Excretion of Quinine by Soldiers in Macedonia*

The excretion of quinine (in six-hourly periods) was followed after the administration of :—

(1) Quinine hydrochloride, twenty grains, by mouth (equivalent to 1·06 gramme quinine base). April 2, 1918.

(2) Quinine bihydrochloride, twenty grains, intramuscularly (equivalent to 1·06 gramme quinine base). April 16, 1918.

(3) Quinine bihydrochloride, ten grains, intravenously in fifteen cubic centimetres normal saline (equivalent to 0·53 gramme quinine base). September 17, 1918.

EXCRETION OF QUININE BASE IN MILLIGRAMMES IN SIX-HOURLY PERIODS.

6-hourly periods	Experiment 1	Experiment 2	Experiment 3
1	63	18	32
2	64	36	20
3	27	31	28
4	18	20	12
5	13	12	Trace
6	9	8	Trace
7	4	3	Trace
8	4	Trace	Trace
9-12	Trace	Trace	Trace
13-16	Trace	Trace	Trace
17-20	Trace	Trace	Trace
Total ..	202	128	92

In the first period of these three experiments the urine was collected every hour, and in experiment 3 at the end of each half hour as well. One cubic centimetre of each of these samples was tested DIRECTLY by Tanret's reagent. In experiments 1 and 3 the first samples showed marked turbidity. In experiment 2 the first sample was clear, indicating a delay in excretion after intramuscular quinine.

In experiment 2 stomach washings twenty hours after quinine injection gave distinct quinine reactions. In experiment 3 stomach washings one hour after quinine injection gave distinct quinine reactions, but twenty-two hours later gave no reactions.

No symptoms were observed in the first two experiments, but in the third experiment from the third hour to the ninth hour there were symptoms of cinchonism (headache, deafness, buzzing, and a metallic taste), with some fever, reaching a temperature of 101·2° F. at the end of the fifth hour.

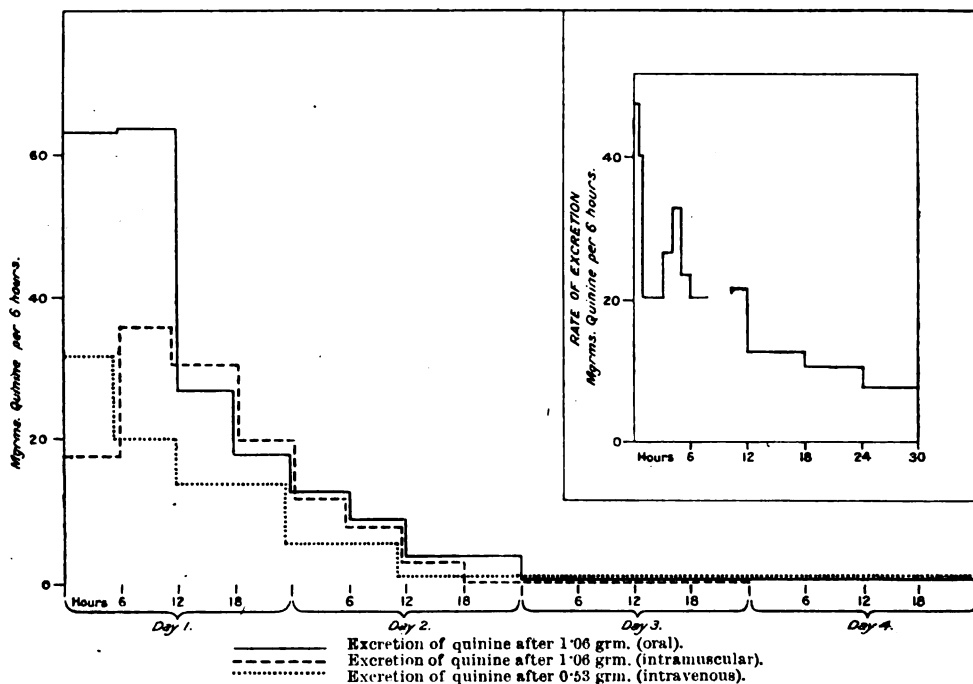
In the third experiment the quinine was also estimated by the Ramsden and Lipkin nephelometric method after preliminary separation of the quinine by picric acid, proportional amounts of urine being used for the two series of estimations. The figures are given in the columns below.

Time	Vol. of urine, c.c.	Mgrm. of quinine bases	Rate of excretion, mgrm. per hour
Day 1—			
1st half hour	365	4.00	8.00
2nd „	200	3.33	6.66
2nd hour	55	3.57	3.57
3rd „	51	3.45	3.45
4th „	71	4.55	4.55
5th „	380	5.55	5.55
6th „	275	3.92	3.92
Total 1st 6 hours ..	..	28.37	..
7—8 hours	327	6.91	3.45
9—10 „	275	4.12 (some lost)	..
11—12 „	250	7.45	3.72
13—18 „	630	13.32	2.22
19—24 „	280	10.70	1.78
Total 1st day .. ..	..	70.87 +	..
Day 2—			
1st 6 hours	275	8.08	1.35
2nd 6 „	220	4.57	0.76
3rd 6 „	405	2.00	0.33
4th 6 „	375	0.88	0.15
Total 2nd day .. ..	..	15.53	..
Day 3—			
1st 12 hours	630	1.26	0.10
2nd 12 „	960	0.69	0.06
Total 3rd day .. ..	..	1.95	..
Day 4—			
1st 12 hours	540	0.64	0.05
2nd 12 „	620	0.51	0.04
Total 4th day .. ..	..	1.15	..

It must be noted that the total given above for the first twenty-four hours is somewhat less than the total given by the picric acid method. The rate of excretion falls off rapidly from the first half hour. The rise in the fourth and fifth hours does not correspond exactly with variations in the volume of the urine.

In experiments 1 and 2 rough determinations by Tanret turbidity after quinine administration by the mouth indicated that the maximum excretion was reached in the second hour, and after quinine administration intramuscularly in the fourth hour.

The excretion of quinine in these three experiments may be expressed graphically thus.



The excretion rate is calculated as milligrammes quinine base excreted per six hours. The rates are calculated from the gravimetric figures.

The inset shows the rate of excretion of quinine after 0.53 gramme given intravenously. In this instance the figures are based on the estimations made nephelometrically. The estimations were actually made on urine, collected in half-hourly or hourly periods, but in order that the graph might be strictly comparable with those, based on the gravimetric estimations, the excretion rates have been calculated as milligrammes per six hours.

The percentage of the dose excreted in the three experiments in the same periods were :—

Dose, gm.	Percentage of dose excreted in 6-hourly periods						Percentage of dose excreted :	
							In 1st 24 hours	Total
1.06 oral	6.0	6.0	2.5	1.7	1.5	0.8	16.2	19.0
1.06 intramuscularly ..	1.7	3.4	3.0	1.9	1.1	0.7	10.0	11.9
0.53 intravenously ..	6.0	3.9		5.4		2.3	15.3	18.5

In all three experiments only traces of quinine were found in the fæces.

These experiments would seem to indicate (1) the more rapid absorption of quinine from a healthy alimentary tract than from muscle ; (2) no great fall in the quinine excretion till the twelfth hour after an oral dose, till the eighteenth hour after an intramuscular dose, and following the immediate fall in the first half hour till the twelfth hour after an intravenous dose.

In experiment 3 nephelometric estimations of quinine in the blood by the Ramsden and Lipkin method gave the following figures:—

8 mins. after intravenous injection of 0.58 grm. quinine	..	1.7	mgram. per 100 c.c.
15 " " " " 0.58 " "	..	0.225	" " 100 "
3 hours " " " 0.58 " "	..	0.105	" " 100 "
12 " " " " 0.58 " "	..	0.116	" " 100 "

This would indicate a constant concentration of quinine in the blood over corresponding periods.

SECTION 3.—EXCRETION OF QUININE IN CASES OF MALARIA.

(a) *Rate of Excretion after Single Doses of Quinine.*—Estimations were only carried out in a few cases, as usually patients, confined to bed and under close observation, received a second dose within a few hours of the first dose.

Case No. M.6007. First attack of malaria, April, 1917; number of relapses, ten; intermittent quinine treatment from April, 1917, to May, 1918; infection, benign tertian malaria. Dose, quinine hydrochloride, June 9, 1918, thirty grains (oral), equivalent to 1.59 grammes quinine base; urine collected every four hours.

Day	Four-hourly periods	Urine		Quinine base excreted		Concentration grm. per litre
		c.c.	sp. gr.	Total mgrms.	Percentage of dose	
1st	1	95	1030	103.0	6.5	1.08
"	2	75	1028	97.0	6.2	1.29
"	3	95	1028	82.0	5.2	0.86
"	4	92	1028	52.0	3.3	0.56
"	5	92	1024	48.0	3.1	0.52
"	6	94	1025	42.0	2.6	0.45
2nd	7	123	1024	27.0	1.7	0.22
"	8	75	1022	19.0	1.2	0.25
"	9	74	1022	7.2	0.45	0.09
"	10	64	1022	3.5	0.22	0.05
"	11	102	1022	2.2	0.14	0.02
"	12	106	1022	1.8	0.11	0.02
3rd .. ..	..	830	1030	5.3	0.34	..
4th .. ..	..	780	1026	0.3	0.02	..
5th .. ..	..	..	..	Nil	Nil	..
Total ..	..	..	..	490.0	30.9	..

The smaller figures in column five were determined by nephelometric estimations on the product obtained by the picric acid method, and therefore can only be regarded as approximate.

The rate of excretion in the above case is very similar to that observed in the healthy individual cited in the previous section, although the patient was suffering from high fever at the time.

258 *The Excretion of Quinine by Soldiers in Macedonia*

Case No. 3010. Intermittent quinine treatment, October to December, 1917; infection, benign tertian malaria. Dose, quinine hydrochloride, March 12, 1918, twenty grains, orally, equivalent to 1·06 gramme quinine base. Quinine base excreted in first twenty-four hours, 127 milligrammes, i.e., 12·0 per cent of dose.

Case No. M.6015. First attack of malaria, April, 1917; number of relapses, three; intermittent quinine treatment from April, 1917, to April, 1918; infection, benign tertian malaria. Dose, quinine hydrochloride, May 25, 1918, twenty grains orally, equivalent to 1·06 gramme quinine base. Quinine base excreted in urine in first two hours, forty-two milligrammes, i.e., 3·9 per cent of the dose.

Case No. M.1001. First attack of malaria, August, 1917; number of relapses, two; quinine treatment, August, 1917, three weeks, thirty grains daily; May, 1918, single dose, twenty grains; infection, benign tertian malaria. Dose, quinine hydrochloride, June 14, 1918, ten grains, equivalent to 0·53 gramme quinine base. Quinine base excreted in first six hours, ten milligrammes, i.e., 1·9 per cent; in second six hours, forty milligrammes, i.e., 7·6 per cent.

This man showed a marked idiosyncrasy to quinine. An urticarial rash appeared after each dose of quinine given.

He received quinine on two days and the daily excretion over the whole period is shown below:—

Date	Dose quinine base grm.	Urine		Quinine base excreted grm.
		c.c.	sp. gr.	
June 14 ..	1·59	1,066	1020	0·114
„ 15 ..	3·18	711	1024	0·239
„ 16 ..	..	759	1030	0·241
„ 17 ..	..	559	1032	0·026
„ 18 ..	..	..	..	Traces
„ 19 ..	..	..	..	Nil
Total ..	4·77	..	..	0·620
Percentage recovered ..		..	..	13·0

There was no obvious failure in the power to katabolize quinine. The excretion of quinine was a little delayed, probably due to a rather slower absorption from the alimentary tract.

Case No. M.6002. First attack of malaria, May, 1917; number of relapses, nine; intermittent quinine treatment from May, 1917, to May 4, 1918; infection, benign tertian malaria. Dose, quinine bihydrochloride, May 13, 1918, twenty grains, intramuscularly, equivalent to 1·06 gramme quinine base. Quinine base excreted in first six hours twenty-seven milligrammes, i.e., 2·6 per cent of dose; second six hours fifty-seven milligrammes, i.e., 5·4 per cent of dose.

These figures agree with those given for the excretion rate after intramuscular quinine in the healthy subject.

Ramsden and Lipkin point out that in one case, liable to blackwater fever, the maximum excretion rate was not reached till the twenty-third hour. Hartmann and Zila place the "acme" of excretion after oral quinine from the fourth to the eighth hour. In active malaria the excretion rate after oral quinine no doubt varies, according to the condition of the alimentary tract, but high fever is not incompatible with rapid absorption and the rapid attainment of the maximum excretion rate, more rapid than after intramuscular therapy. If the excretion rate is any measure of the quinine concentration in the blood, the comparatively constant character of this rate is of considerable significance in the treatment of active malaria.

(b) *Excretion of Quinine during Short Combined Courses.*—A few cases were selected and the excretion of quinine was followed from day to day. This plan was adopted in order to check any failure in the proper collection of urine, or in the administration of quinine.

The percentage of the dose recovered over the whole period of each experiment varied from ten to twenty-one per cent. As the table below shows, most of this quinine was excreted in the first twenty-four hours, though traces of quinine were found in the urine from three to seven days after the cessation of the course. Individual variations occurred, but the variations bore no relation to the course of quinine treatment. The daily excretion of quinine on a constant dose of intramuscular and oral quinine combined was very constant, but on a constant dose of oral quinine alone frequently showed wide variations, even when there was no doubt as to the regularity of the administration. The courses investigated were:—

- (1) Quinine hydrochloride, sixty grains oral, daily.
- (2) Quinine hydrochloride twenty grains oral; forty grains subcutaneous, daily.
- (3) Quinine hydrochloride twenty grains oral; bihydrochloride forty grains intramuscular, daily.
- (4) Quinine hydrochloride twenty grains oral; bihydrochloride forty grains intramuscular, daily for twelve days, followed by oral quinine for seventeen days (Course C 17 of Ross).
- (5) Quinine hydrochloride, twenty grains oral, bihydrochloride, thirty grains intramuscular, daily, with galyl 0.2 gramme intravenously once a week.
- (6) Quinine hydrochloride, twenty grains oral, forty grains subcutaneous, bihydrochloride twenty grains intramuscular, daily.
- (7) Quinine hydrochloride, twenty-five grains oral, fifty grains subcutaneous, twenty-five grains rectal.

The percentage of quinine eliminated in the urine, as given by different workers, varies within wide limits. Of more recent work Nierenstein's figures (twenty-eight to fifty-seven per cent) are considerably higher than

260 *The Excretion of Quinine by Soldiers in Macedonia*

the values given above. Ramsden and Lipkin have pointed out that on a high dosage (ninety grains a day on each of two successive days), the percentage is very low (6·7 to 10·6), while with smaller doses the percentage is higher e.g., with 238 milligrammes orally, 23 per cent, with 480 milligrammes intravenously, 37 per cent, and with 2,150 milligrammes orally, 24 per cent. Nierenstein's figures to some extent agree with this general thesis that the smaller the dose the higher the percentage excreted. The dosages shown in the table mostly approximate to the higher doses in Ramsden and Lipkin's summary. This may perhaps account for the low percentage figures. However, the percentage figures given for the excretion of quinine in the healthy subject under Section 2 above are also low, although the dosage was small.

Case No.	Course given	Quinine base, daily, grm.	Days tr.	Days quinine excreted, after course	Quinine excreted during, and one day after course		Quinine excreted later than one day after course, grm.
					Grm.	Per cent of whole dose	
3007 ..	2	3·18	4	3	1·574	12·4	0·030
M. 8002 ..	3	3·18	4	4	1·740	13·7	0·158
		3·18	4	5	1·973	15·5	0·071
M. 6002 ..	3	3·18	4	4	1·951	14·2	0·106
M. 5002 ..	5	2·65	4	7	1·803	17·0	0·089
		2·65	4	6	1·239	11·8	0·131
6004 ..	6	4·24	2	7	1·260	14·9	0·154
M. 2004 ..	1	3·18	4	4	1·913	15·0	Trace
M. 6015 ..	1	3·18	2	3	0·805	12·6	0·008
3014 ..	7	5·30	1	5	0·524	10·2	0·019
See subject. (e)							
M. 3014 ..	(Oral) 4	1·59	11	Average daily excretion.. 0·188 grm. (11·8 per cent)			
		3·18	12	" "	" .. 0·689	" (21·7	")
		3·18	3	" "	" .. 0·529	" (16·6	")
		1·06	14	" "	" .. 0·147	" (13·8	")

(c) *Excretion during Continuous Oral Quinine.*—Teichmann, using a rough clinical method, has asserted that patients who are habituated to quinine excrete less than those who are not so habituated. A series of observations was therefore made on men who had received during the previous two years considerable amounts of quinine, but who had not received quinine for some days previous to a month's course of quinine given orally. The urine was collected at the commencement of the course for a period of four days, and also at the end of the course over a similar period, and the excretion compared at the beginning and end of the course. The results are given in the table below. There is no evidence of any decrease in quinine excretion in these figures, but rather a slight increase, not perhaps large enough to be of any significance.

In the previous section, the percentage of the doses excreted during the course of treatment of Case No. M3004, is lower towards the end, but the

method of administration and dosage of quinine is not the same throughout the course.

Case	Dose grm. quinine HCl daily	Equivalent to grm. base	Days tr.	Days of course examined	Average daily excretion base grms.	Percentage recovered
M. 7002 ..	20	1.06	28	5—8	0.173	16.4
	20	1.06	28	24—27	0.227	21.5
M. 7004 ..	20	1.06	28	4—5	0.134	12.7
	20	1.06	28	12—14	0.124	11.8
	20	1.06	28	23—26	0.168	15.9
M. 7033 ..	45	2.385	30	8—11	0.422	17.7
	45	2.385	30	28—30	0.471	19.8
M. 7015 ..	45	2.385	30	7—10	0.445	18.8
	45	2.385	30	27—30	0.499	21.0
M. 7017 ..	45	2.385	31	7—10	0.429	18.1
	45	2.385	31	28—31	0.526	22.1

(d) *Excretion during and after "Week-end" Quinine.*—Estimations were carried out on the urine of patients, taking quinine by the mouth on the Saturday and Sunday of each week, in order to arrive at some idea of the length of time during which quinine remained in the system:—

Case	Dose grm. quinine HCl oral, daily	Equivalent to grm. base	Days tr.	Days quinine excreted after course	Quinine excreted on Satur- day, Sunday, Monday		Quinine excreted after Monday
					grm.	Per cent	
M. 12022 ..	45	2.385	2	3	1.186	25.0	0.067
B. 5011 ..	30	1.59	2	2	0.791	24.9	0.017
B. 6002 ..	30	1.59	2	2	0.776	24.4	0.014
M. 12007 ..	45	2.385	2	2	0.647	13.6	0.005
	45	2.385	2	2	0.589	12.4	0.018
M. 12021 {	45	2.385	2	2	0.659	13.8	0.014
	45	2.385	2	2	0.373	11.8	0.002
B. 5004 ..	30	1.59	2	2	0.411	13.0	0.002
B. 6016 ..	30	1.59	2	2	0.411	13.0	0.002
T.	30	1.59	2	2	0.447	14.1	0.008

As might be expected the greater bulk of the excreted quinine is excreted within twenty-four hours of the last dose. Traces persist for another twenty-four or forty-eight hours. This last observation was confirmed by examining urines for Tanret turbidity from a large number of patients on "week end" quinine.

It is seen that these cases fall into two groups, those in the first group excreting about double the percentage of the dose as compared with those in the second group. There were no intestinal symptoms to suggest any failure in absorption in the second group. The faeces contained only traces of quinine. A preliminary dose of calomel has been recommended as assisting the action of quinine. Four men of the second group were given calomel, three grains, followed by a saline purge, twenty-four hours before they were given the first dose of "week end" quinine, and estima-

262 *The Excretion of Quinine by Soldiers in Macedonia*

tions were carried out on the urine as before. The calomel had no appreciable influence on the quinine excretion. Again only traces of quinine were found in the fæces:—

Case	Dose grm. quin. HCl oral, daily	Equivalent to grm. base	Days tr.	Days quin. excreted after course	Total quinine excreted	
					grm.	Per cent
M. 12007 ..	45	2·385	2	2	0·455	9·6
M. 12021 ..	45	2·385	2	2	0·500	10·5
B. 5004 ..	30	1·59	2	2	0·421	13·3
B. 6016 ..	30	1·59	2	2	0·264	8·3

(e) *The Excretion of Quinine in Cases of Blackwater Fever.*—Estimations of quinine were carried out on the urine of seven cases of blackwater fever. The permeability of the kidney to quinine has been much discussed in relation to quinine as the possible causative factor. In the two cases recorded by Nierenstein the excretion of quinine in the one case was practically normal, and in the other case it was reduced to the utmost minimum. In the case recorded by Ramsden and Lipkin the excretion was low, and the observers draw attention to the fact that the quinine content of the urine is from ten to 390 times that of the blood. Unfortunately in the present series quinine determinations in the blood were

Case	Quinine, dose, grm.	Given hours previous to collection of urine	Total quinine recovered, grm.	Expected quinine excretion, calc. for same period from table for normal man, grm.
(1) 3014	0·79 oral 1·06 „	23 14	0·085	0·108
(2) 2019	1·06 subcutaneously .. 1·06 „	During collection		0·232
(3) McN.	0·53 oral 1·06 intramuscularly .. 1·06 oral 1·06 „	30 14 6	0·228	0·239
(4) Ba.	0·64 intravenously .. 1·06 intramuscularly .. 0·64 intravenously .. 1·06 intramuscularly	14 12 During collection „ „	.. 0·217 .. ..	.. 0·274
(5) Be. ..	1·06 „	9	0·079	0·092
(6) Iv. ..	0·53 intravenously ..	—	0·013 (in first six hours after injection)	0·032
(7) Ho. ..	2·12 intramuscularly	Three days	Trace	?

not carried out *pari passu* with the estimations on the urine. An attempt has been made to compare the quinine excretion in blackwater fever with that of the normal man cited in section 2. In the last column is the quinine excretion, calculated from the table given in section 2, that would be expected to have taken place in the periods during which the cases were under observation, from the quinine administered before and during the excretion of blackwater urine. Of the six cases that recovered, two were treated throughout the illness with intravenous, intramuscular and oral quinine. (See table on preceding page.)

In the cases of "Ba" and "Iv" blood quinine determinations by the Ramsden and Lipkin method were carried out after intravenous injection of quinine. The figures cannot be compared directly with those for the urine as the times of collection do not strictly correspond.

Case	Dose, grm. quinine base	Quinine base in 100 c.c. after—			
		2 minutes	11 minutes	6 hours	18 hours
Ba.	0.64	1.2 mgrm.	—	—	0.56 mgrm.
Iv.	0.53	—	0.32 mgrm.	0.23 mgrm.	—

These figures should be compared with the normal figures given in section 2, and with Ramsden and Lipkin's figures after intravenous quinine.

	Dose given, grm.	Quinine base in 100 c.c. blood after—				
		1 minute	8 minutes	15 minutes	8 hours	12 hours
Normal case in Section 2	0.53	—	1.70	0.225	0.105	0.116
R. and L.'s figures—						
1	0.53	4.42	—	—	—	—
2	0.53	2.36	—	—	—	—
3	0.48	1.66	—	—	0.442	—

Of the seven cases all recovered save the last, "Ho." The six men who recovered passed a large volume of urine each day. The seventh man had complete suppression of urine for three days before death. About fifty cubic centimetres of urine removed from the bladder after death contained traces of quinine. The liver at death contained 40.6 milligrams of quinine, though the last dose of quinine had been given three days previously.

The excretion of quinine in the men who recovered, with the exception of Case 6, Iv, does not compare unfavourably with the normal excretion.

264 *The Excretion of Quinine by Soldiers in Macedonia*

The values for the blood quinine are not very different from the normal values. There are not, however, sufficient data for comparison.

SUMMARY.

(1) The picric acid method for estimating quinine is sufficiently accurate for a clinical laboratory. It can be used with advantage when the apparatus is limited.

(2) In health quinine is eliminated more rapidly after oral than after intramuscular administration (one case).

(3) The excretion rate of quinine in health shows no great fall from the second to the twelfth hour after an oral dose, from the fourth to the eighteenth hour after an intramuscular dose, and from the second to the twelfth hour after an intravenous dose. It is suggested that the quinine concentration in the blood is relatively constant over the same periods (one case). The excretion rate of quinine falls off rapidly after the first day. Elimination may continue for ninety-six hours.

(4) The excretion rate of quinine in malaria is similar to that in health, but there is greater variation, as would be expected, after oral administration.

(5) In cases of malaria the excretion of quinine shows individual variations, but in the series quoted there is no constant difference observed under different forms of therapy. The amount recovered from the urine varied from ten to thirty per cent of the administered dose.

(6) There is no evidence of any decrease of quinine elimination during a course of treatment.

(7) The excretion of quinine in five cases of blackwater fever was only a little less than normal. In a sixth case the excretion of quinine was less than half the normal. All these cases were passing a fair volume of urine and recovered.

In a seventh case where there was suppression of urine for three days only traces of quinine were found in the urine removed from the bladder post mortem. There were forty milligrammes of quinine in the liver of this case.

(8) The fæces of all cases given in this report were examined for quinine. Only traces were detected.

APPENDIX.

(1) QUININE IN TISSUES.

Investigations on the quinine content of the liver, etc., were commenced in the late autumn of 1918, shortly before the work of the unit ceased. The method employed was a combination of the Stas Otto and picric acid methods as practised by Captain Ferrey in the Central Laboratory of the same Command. Only a few estimations were completed, and these corre-

spond to those published from the Central Laboratory by Colonel L. S. Dudgeon, C.M.G., A.M.S. The results are shown in the table below:—

Case	Quinine administered, base		Death	Post-mortem hours after death	Liver			Muscle	
	Date	Dose			Weight gm.	Quin. per 100 grm.		R. buttock	
						3 hours after death, mgrm.	24 hours after death, mgrm.	Weight, grm.	Total quinine, mgrm.
M.	Nov. 4	3.18 grm. oral	6.10 a.m.	3	2,140	37	15	480	108
	Nov. 5	3.18 " "							
	Nov. 6	1.06 " "							
		1.06 " intra-muscularly (L.)							
		1.06 grm. intra-venously							
	Nov. 7								
	3 a.m.	1.06 grm. intra-muscularly (R.)							
	6 a.m.	0.53 grm. intra-venously							
B.	Nov. 3	0.53 grm. intra-venously							
	9 a.m.	1.06 grm. intra-muscularly (R.)							
	Noon	0.53 grm. intra-venously							
	3 p.m.	1.06 grm. intra-muscularly (L.)							
	Nov. 4								
	10 a.m.	1.06 grm. intra-muscularly (R.)							
	3 p.m.	1.06 grm. intra-muscularly (L.)	4 p.m.	2	1,640	15.6	12.0	710	142
Ho.	Oct. 23	1.06 grm. oral	Oct. 26	2	1,450	2.8	—	—	—
		1.06 grm. intra-muscularly							

NOTE ON PIGMENTS OBTAINED FROM THE URINE.

During the epidemic of influenza in the autumn of 1919, specimens of urine were examined for urobilin. Cases uncomplicated by active malaria showed only traces of urobilin in the urine. In cases complicated by active malaria, there was always, as might be expected, an increase in the output of urobilin. When there was a heavy malaria infection, with consequently much blood destruction, the urine had the characteristic colour of urobilinuria, that could be recognized from a distance, without any tests being necessary. No stress should be laid on the diagnosis of malaria, from the presence or absence of a marked urobilinuria, but from the naked eye appearance of specimens of urine in a ward filled with men from a malarious district it would be possible at once to pick out cases with a heavy malaria infection, and so prevent in the absence of hæmatological report unnecessary mistakes.

A pigmented substance, soluble in chloroform and exhibiting a broad dark band between C and D of the spectrum, in much the same position as the band of alkali-hæmatin in the red, was frequently found in the urine of patients taking quinine. If the blue pigment was encountered in the examination of the urine of any case, it was always found in the urine of that case so long as he was excreting quinine. The pigment was only found in the urine of one case of blackwater fever (3,014), and in this case examinations were made two months before the attack of blackwater fever, and ten days after the attack; on all occasions the blue pigment was present.

It is of interest to note that in the experiments on the normal individual, cited in section 2, the blue pigment was found after the intravenous dose but not after the oral or intramuscular dose. Its presence is not, however, universal, after intravenous quinine.

There was no opportunity to determine the nature of this pigment, and whether its appearance depends on the presence of picric acid or not is not known.

This note is added to draw the attention of other workers to a matter which might prove of interest in the course of their work.

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A FIELD AMBULANCE IN ANATOLIA.

BY BREVET MAJOR R. E. BARNSELEY.

Royal Army Medical Corps.

THE functions of field ambulances during the Great War were so many and so varied that it is almost inevitable that prolonged discussion should frequently arise as to whether, or in what way, these important units should be modified as regards their equipment, training, or utilization.

Among those whose experiences were confined to the Western Front, one finds an idea, expressed or implied, that the field ambulance as at present constituted is something of an anachronism. Where experience has shown that these units were almost invariably housed in buildings and dug-outs, that casualties were conveyed by motor ambulance car or light railway, that horse-drawn transport proved a slow and dangerous method of evacuation, and that tentage could always be drawn if required from the nearest Ordnance depot, it is not surprising to find a widespread opinion that all transport should be mechanical, that tentage and other stores should be thrown overboard to make room for, perhaps, more complete theatre equipment, X-ray apparatus, or other stores more directly concerned with the treatment and comfort of the sick and wounded.

Since returning to England I have heard these views so repeatedly emphasized that it may be not without interest to recall recent operations in which field ambulances worked "according to the Manual," and in which any such drastic modifications of the present organization would have proved a very great embarrassment.

The town of Ismid is situated at the eastern end of the Gulf of Ismid on the Sea of Marmora. It lies in the concavity of a roughly semi-circular ridge of hills which stops short of the sea at either end and enables the road and railway to pass on the east to Ada-Bazar and Eski-chehir and on the west to Derinje, Tousla and Constantinople.

This town was occupied by an independent Brigade which was served by a combined British and Indian field ambulance.

The work of the Brigade may be said to have started in March, 1920, when the Turkish Nationalists blew up a railway bridge on the Ismid-Eski-chehir line about sixty kilometres from the former place. The Force moved up by rail to protect the parties working on the repair of the bridge and to assist in the extrication of the Eski-chehir force which was thereby cut off.

A main dressing station was established in trucks on a siding at rail-head and a collecting post, under canvas, was sent forward three or four miles to the Brigade encampment, which was under bivouacs.

At this juncture a need was felt, which must have been experienced by

a large number of units during the war, of some sort of "emergency" or "detachment" equipment.

How many times has the moment come when a post has to be formed at short notice, or when a medical officer has suddenly to be detailed to take a field ambulance detachment to accompany some small independent force?

Such orders often result in a sudden dash to the store, the hurried unlocking of eight Ordnance panniers, the extraction of a bedpan from one, pyjamas from another, a Primus stove from a third, a directing flag from a fourth, and so on, what time the hapless Quartermaster wrings his hands in despair as to how to keep track of his equipment. It was found in practice that all the medical and surgical equipment required can be carried in a medical companion if the dressings are removed and for them are substituted a sterilizer, some anti-tetanic serum and syringe, dental instruments, extra drugs such as aspirin, quinine and castor oil, clinical thermometers, and a set of ordinary instruments (medical officers are not infallible and their pocket cases are sometimes absent or incomplete when required). For the rest, surgical haversacks supply the dressings necessary and, in addition to the Ordnance stores suggested above, a pannier is packed with electric torch, stationery, matches, candles, methylated spirit, paraffin, hurricane lamp, basins, soap, towels, and other essentials which will occur to all who have had experience of this kind of work.

Such equipment would be of very great service for a regimental medical officer to take with him to his aid post for active operations. At the present time if he takes all his authorized equipment he is burdened with a large number of drugs and instruments he cannot possibly require during an engagement and, on the other hand, for such essentials as bedpans, etc., he has usually to rely on the generosity of the field ambulance.

In spite of some opposition the bridge was satisfactorily repaired and all the troops returned, with negligible casualties, to Ismid.

Here we remained for about three months; this time was not destined to hang heavily on our hands, however, as the Nationalists made repeated efforts to capture the town and frequent alarms were the order of the day. In addition to a number of battle casualties there was a considerable amount of sickness which is, I suppose, inevitable when young and newly recruited troops are brought, under active service conditions, to a semi-tropical and malarial climate.

During this time the force was supported by the Royal Navy, and it is pleasant to recall the valuable assistance given by the medical staffs of H.M.S. "Ramillies" and the other vessels which at different times lay in the bay. Expert professional advice was always readily given and we gratefully availed ourselves of their kind offer to let us have the use of X-ray apparatus, oxygen cylinders, instruments and drugs from their perfectly equipped hospitals.

About two-thirds of the force, during this stationary period, was distri-

buted on the surrounding hills and evacuation by wagon was an impossibility. Fortunately mule litters arrived shortly before the investment of the town and all cases were brought down by this means. It may not be out of place here to interpolate a few observations with regard to this most useful means of transport. The litters did not vary in essentials from the kind described in the Manual and, as all who served in Macedonia or Turkey will agree, they were of the very greatest service under all conditions.

In standing camps, where sick have to be brought in from neighbouring units, a litter could be turned out in half the time and with half the trouble that it took to harness up an ambulance wagon; it could be taken direct to where it was required, across fields and nullahs or along narrow tracks, where a wagon would have to go several miles round by road, and it was undoubtedly the most comfortable of all means of transporting patients. In open warfare the litters proved an immense saving of stretcher-bearer personnel as they were almost always taken up to aid posts and places where, on account of its visibility, an ambulance wagon was out of the question. When infantry patrols were sent out a couple of litters were sent along with the ammunition mules to bring in any casualties which would otherwise have to be left behind or carried perhaps eight or nine miles. In the case of cavalry patrols they would go out and lie up in some convenient spot, under shelter of a hedge or in a nullah, and could be brought up to collect a casualty over any country in which cavalry can work. In fact, at the present time, the litter seems to be the nearest approach to the solution of the difficult problem of providing suitable ambulance transport for cavalry work. Furthermore, I am convinced that they have a definite place in trench or stationary warfare and can recall very many occasions in France when they could have replaced stretcher-bearers in positions where shell holes, bad roads, mud, or exposure to view precluded the use of wagons. A very efficient form of litter and harness, which carried an ordinary stretcher, was evolved in Macedonia and it would seem very unfortunate if field ambulances were not to benefit by the hard-won experience of that campaign.

In July, having suffered considerable losses, the Nationalists abandoned the idea of capturing Ismid and withdrew into the interior. Many broke up into marauding bands which carried murder and rapine into the Greek and Armenian villages of Anatolia. About the middle of the month, therefore, a force from Ismid started on an expedition to the Black Sea with the idea of clearing the country, laying by the heels any such bands in the neighbourhood, and establishing some sort of government and order.

This short expedition (which only lasted something under a month) proved of the greatest interest and impressed many valuable lessons on the medical officers taking part. It was clear at the outset that there would be a considerable number of casualties. Malaria and dysentery were exacting a heavy toll on both British and Indian troops and, in addition, we were setting out into a strange and hostile country, so that the prospect of there being a number of battle casualties was not lightly to be set aside.

Personnel and transport had to be reduced to a minimum owing to rationing difficulties and when the column started out the field ambulance was reduced to little more than a section. Panniers A to H were completely overhauled and it was found that by careful selection and packing all the essentials could be contained in four panniers.

There was to be no opportunity for the transfer of patients until the Black Sea was reached, where a ration boat was to be in waiting, and there was no means of communicating with higher formations other than by the rather precarious medium of a travelling wireless set.

At the beginning of the march the field ambulance was distributed through the column in a way which has been found to have many advantages. The transport (other than the ambulance transport proper), together with a party for tent pitching, cooking, etc., marched near the head of the main body. The ambulance wagons and litters were placed at the head of the second line transport. The advantages of this system are obvious. The equipment is among the first to arrive in camp, and the fatigue party is able to erect tents, prepare a medical inspection room, and get fires going without delay, so that when the ambulance wagons arrive, patients can be accommodated and fed almost at once, and field ambulance personnel can get to rest in reasonable time. There is no doubt that in a march where opposition is not expected and a field ambulance is at full strength, this disposition is entirely satisfactory. Where there is a possibility of attack, however, it is perhaps not advisable to have a field ambulance detachment in the front of the column; moreover, in the case under discussion, owing to a dearth of personnel, the preparation of camp had to be done by wagon orderlies, etc., and it was not possible to detail a special party for the purpose. Finally the supervision of so widely distributed a unit became a difficulty, and it became necessary to alter the position on the line of march to that which is described in a later paragraph.

It speaks volumes for the spirit and determination of the troops to recall that the numbers actually falling out on the march were almost negligible. In spite of a trying climate and long daily marches, it was a bad day when the numbers falling out could not be counted on the fingers of the hand. On arrival in camp however, temperatures rose, rigors set in, sore feet became no longer endurable, and the problem of how to dispose of the sick became increasingly formidable.

It soon became obvious that local transport would have to be used to an increasing extent and the commonest vehicle in the country proved admirably adapted to the purpose. This consisted of a wagon drawn by two oxen. It was very long and narrow. The distance between the front and rear axles was about eight to ten feet, the width was about two feet six inches. The floor consisted of long planks, and the sides were formed by a wooden railing, about three feet in height, sloping outwards from the floor. In some cases a stretcher was slung from the railing but

in practice it was found that a patient was equally comfortable lying on a bed of straw on the body of the wagon. A canopy was, of course, erected as a protection from the sun.

How efficient a means of transport these wagons proved may be judged from the fact that an officer, badly shot through the knee, asked to be transferred from the light ambulance wagon on which he was travelling, back on to the ox wagon on which he had started his journey. The highly sprung ambulance wagon with its short wheel base plunges, as it were, whole into any inequalities on the road, setting up both lateral and to and fro movements which are very distressing to patients and which were, in this instance, likened to those of a small boat in an angry sea. The ox wagons, on the other hand, with their great length met these obstacles first with their front wheels and, after a distinct pause, with their hind wheels, moving slowly and inexorably forward with the calm dignity of an ocean liner.

During the daily march, mounted transport men were sent out on either flank to collect wagons from fields and villages and to bring them into the column. The owners were in nearly every case fine specimens of the unspoiled and country-bred Turk who is as the poles apart from his shifty and unstable brother in Constantinople. Generally they were old men, often of seventy years and more, but they would march a steady sixteen miles a day without turning a hair, and the scrupulous way in which they tended, watered and fed their beasts before satisfying their own needs would not have been discreditable to a British cavalry regiment.

When paying off one of these old men I asked him whether he did not find it, to say the least, a little disconcerting to find himself in the midst of his peaceful daily labours suddenly swooped down upon and compelled to join the ranks of a foreign army. His reply forms an interesting commentary on the capacity of the Turk to govern. He said that he was over seventy years old and that all his life he had either been fighting or had been the victim of constant raids, robbery and oppression. (In fact, from some remarks let fall, I rather gathered that brigandage had been an early hobby of his own.) The local custom appears to be to seize the wagon and oxen, to load it up with the victim's produce and leave him disconsolate by the roadside, lucky if his house and women folk are untouched. It was rather a pleasant surprise, therefore, to find a misguided people like ourselves who supplied him and his beasts with food and liberated them only two days from home with rations on his wagon and good money in his pocket.

Cases of sore feet, minor injuries and trivial disabilities were carried on army transport carts as they became emptied of the rations with which they had been loaded. These did not prove very satisfactory as the lack of springs, hard iron floor and awkward slope of the cart all militate against its usefulness.

After several trials it was found that the bulk of the field ambulance

could be most usefully employed when marching immediately in rear of the first line transport. Difficulties have sometimes been encountered with brigade staffs who are often anxious to relegate the field ambulance to the second line transport. This is obviously a most undesirable position as it means that the medical unit arrives very late into camp, that sick parades are thereby delayed, that the casualties are last in the brigade to be accommodated and that field ambulance personnel, by the time that the hospital is established, get very little rest. Field Service Regulations lay down that field ambulances are not divided into first and second line transport. Would it not be more accurate to say that *all* field ambulance transport is first line?

One or two litters were sent with each flank guard and care was taken to ensure that all ambulance transport proper started clear of patients each morning.

Slight cases followed in army transport carts with the second line transport and, in the rear of the column, in front only of the rearguard, followed the local transport which formed, as it were, a kind of slowly-moving main dressing station. When it is stated that as many as eighty patients were carried in this at one time, it will be realized that this part of the field ambulance assumed very considerable proportions. Contrary to expectations it was found that these ox wagons were well able to keep up with the brigade even on a long day's march. As a rule they only had one halt during the day, so that, while they receded when the column was moving, at every check or halt they tended to regain their position, and, in practice, never arrived in camp more than three-quarters of an hour after the main body, by which time tents were erected to receive their loads.

Finally, one ambulance wagon was detailed to march with the rearguard.

Two Ford vans which accompanied the column had the greatest difficulty in keeping touch, were of very little practical use, and ended by being drawn ignominiously into camp by oxen.

During the summer the amount of sickness, combined with the reduction of personnel owing to demobilization, had prevented training in field work on any large scale, and it became very apparent that constant practice in the pitching of tents and the establishment of camps should figure very largely in the training of Royal Army Medical Corps personnel. There is little doubt that this is likely to be of more actual use on service than stretcher drill or wagon drill, though at the present time it is doubtful if it is given even an equal prominence.

Other difficulties and problems which had to be faced, including evacuation by trawler and destroyer in rough seas are, perhaps, not of sufficient interest to be described in full. They all went to show, however, that the training of men to use their own initiative and the development of their powers of improvisation are at least as important as specialized

instruction in the technicalities of hospital treatment and routine; and that a field ambulance equipment and transport should be adaptable for use under all conditions.

After all only a very small proportion of the earth's surface is supplied with roads and buildings and, though the present field ambulance, based on the South African War, proved wonderfully adaptable to warfare in thickly populated industrial countries, can we be sure that the converse would be the case? and is it not possible that such a unit, modified to meet the requirements of France and Belgium, might find itself in very serious difficulties in attempting to work over country such as Anatolia?

It would be idle, after a comparatively limited experience, to be in any way dogmatic as to the ambulance transport required by a field ambulance at the present time. It may perhaps provoke interesting discussion if it is suggested that the widest demands would be best served by the provision of four motor ambulance cars, seven light ambulance wagons, ten litters and (is it too much to hope?) an ambulance aeroplane lying somewhere at hand for the conveyance of abdominal or other urgent cases.

A CONTRIBUTION TO THE HISTORY OF THE CARE OF THE SICK AND WOUNDED DURING MARLBOROUGH'S MARCH TO THE DANUBE IN 1704, AND AT THE BATTLE OF BLENHEIM.

By G. E. GASK, C.M.G., D.S.O., F.R.C.S.

" Not the great nor well bespoke,
But the mere uncounted folk
Of whose life and death is none
Report or lamentation."

MARLBOROUGH'S march to the Danube, culminating in the victory of Blenheim, ranks as one of the world's great feats of arms. Very little has been written about the arrangements made by Marlborough for the treatment of his sick and wounded in that campaign. It may be of interest to consider what these arrangements were and to piece together the few facts which have been recorded.

Medical Establishment.—It is necessary first to review the constitution of the Medical Establishment of the British Army at the commencement of Marlborough's campaigns in 1702. The Regimental medical personnel consisted of surgeons and surgeons' mates, these being one surgeon and one surgeon's mate to each regiment of horse or foot. The surgeons were qualified men and commissioned officers. The surgeons' mates, who had been added to the Establishment in 1673, were of warrant rank only. The qualifications for a surgeon's mate were very low; in early times they were often apprentices of the surgeons. [Colonel Wm. Johnston, "Roll of Commissioned Officers in Medical Service of British Army, 1727-1898." 1918.] Many surgeons were promoted from the ranks of the surgeons' mates.

The need of medical officers of higher rank to direct army medical concerns led to the appointment of Physician-General, Surgeon-General and Apothecary-General. [Colonel Wm. Johnston.] It was also common practice when an army took the field for a physician to be appointed to the staff of the General Officer Commanding.

Garrisons also required a separate medical establishment and physicians, surgeons and surgeons' mates were appointed to them. [Colonel Wm. Johnston.]

HOSPITALS.

Prior to the wars during the reigns of William and Mary, Field Hospitals had occasionally existed, as in the army of Henry of Navarre and during the war for the Conquest of Granada under Ferdinand and Isabella of Spain.

William III appears to have been the first to realize their value as part of the necessary establishment of a British army in the field, and such hospitals, then called Marching Hospitals, accompanied our army during William III's campaign in Ireland.

The earliest appointment to these hospitals is that of Francis Smith, M.D., "to be Physician to the Marching Hospital," December 28, 1689. [W.O. Book 1259—quoted by Colonel Wm. Johnston.]

The hospitals established by William III were under the command of Directors who were not medical officers. Colonel Wm. Johnston states that these hospitals required a special medical personnel and that they also had nurses, cars for the transport of sick, drivers and men-servants. He omits, however, to quote his authority for this statement, and as regards the campaigns of Marlborough there is no hint that they had nurses or any form of transport, in fact, what evidence exists is to the contrary.

THE MEDICAL SERVICES UNDER THE COMMAND OF MARLBOROUGH.

The names, ranks and dates of commission of the medical officers serving in the British Army under Marlborough are included in "English Army Lists and Commission Registers, 1661-1714," edited by Charles Dalton. London, 1902.

From these Lists it is clear that each regiment of Horse or Foot had its own medical officer, termed either Chirurgeon or Surgeon, and in many regiments, but by no means all, there was a surgeon's mate as well, and as time went on some of the mates were promoted surgeons. The Train of Artillery consisting of fifty-two pieces, raised by Royal Warrant in 1702, had two medical officers attached with the title of Master-Surgeon and Assistant-Surgeon respectively. Their names were John Girle and John Pawlet. They both took part in the battle of Blenheim, but at the battle of Malplaquet John Pawlet had become the Master-Surgeon.

The highest posts in the medical service—Physician-General, Surgeon-General and Apothecary-General—were filled by Dr. Thomas Lawrence, Thomas Gardiner and Isaac Teale.

Dr. Thomas Lawrence was commissioned August 24, 1702, "to be Physician-General of our Land Forces." He had been appointed to a similar position in Ireland on March 9, 1689, and was First Physician to Queen Anne. He served throughout Marlborough's campaigns, was present at the battles of Blenheim and Malplaquet; and—according to the *Gentleman's Magazine*, vol. lvii, part 1, p. 291—"he lived to a great age and held appointments under four successive princes, beginning with Charles II, by whom he was appointed physician to the garrison of Tangier, part of the dowry of Queen Catherine."

Thomas Gardiner was Master of the Barber-Surgeons Company in 1697 [Sidney Young] and was Serjeant-Surgeon. He was "Chirurgeon of the Household" to King William III at a salary of £280 per annum

276 *Care of Sick and Wounded during Marlborough's March*

[Chas. Dalton]. On August 24, 1702, he was commissioned "To be Surgeon-General of our Land Forces." He was also termed Surgeon to the Captain-General (i.e., Marlborough). He was present at the battles of Blenheim and Malplaquet.

Isaac Teale was appointed Apothecary-General on September 3, 1702. He appears in the Blenheim Roll in the Hospital List.

HOSPITALS.

That one hospital followed Marlborough's Campaign of 1704 is certain. It is very doubtful if there was more than one. Temporary depots for sick men may have been made from time to time, but there is evidence of only one established hospital, which is generally referred to as "The Hospital."

For knowledge of the staff of the hospital we are indebted to the fact that a Nominal Roll of the officers serving at Blenheim had to be made out for the Bounty Roll.

This list includes: The physician-general; two physicians; the director and two clerks; the apothecary-general; two apothecaries; nine surgeons. [Chas. Dalton.]

Before pursuing further the actions of the medical officers, it is necessary for the understanding of the same to make a short résumé of the military situation in Europe at the beginning of 1704 and the reasons which led Marlborough to march to the Danube.

MILITARY SITUATION IN EUROPE IN 1704.

Under Louis XIV the might of France proved a disturbing factor to the Peace of Europe, and a formidable coalition was formed against her. Though this war is called the War of the Spanish Succession, it seems quite clear that the other countries were less anxious as to the person of the Ruler of Spain, rather than to reduce the "exorbitant power of France."

William III had been the prime mover in forming an alliance of the European powers against Louis, and to unite them for the greatest conflict he devoted the last efforts of his life.

Though they were not very good friends, yet William believed that Marlborough was incomparably the best soldier and best negotiator in the three kingdoms and with his dying breath he certified him to Anne to be "the fittest person in all her dominions to conduct her armies and preside in her councils." [Taylor's "Wars of Marlborough."]

Queen Anne conferred the Order of the Garter on Marlborough, appointed him Captain-General of the Forces, and, within a fortnight of William's death, sent him to The Hague as Ambassador Extraordinary and Plenipotentiary to the States General. Shortly afterwards he was given supreme command of the Dutch Army.

According to Taylor, Marlborough's idea of strategy was essentially modern. It was to crush the French armies in the field and to pursue their demoralized remnants to the French capital. He knew the way. It was up the Moselle.

At the opening of the campaign in 1702, there was no question of invading France. The immediate necessity was to clear the Dutch frontier where the French pressure was dangerous to the Allies. To accomplish this the campaigns of 1702 and 1703 were both spent, though if unhampered by the stupid timidity of the Government of The Hague Marlborough would have completed the task more expeditiously.

Now in 1704 the very existence of the Coalition was threatened by Marshal Villar's brilliant thrust towards Vienna. He designed to annihilate Austria by the capture of her capital. Marlborough realized that the coalition could not hope to survive the downfall of the Austrian power. Both Prince Eugène and Marlborough appreciated the danger and agreed that the mischief could only be remedied by a concentration of the Allied Forces and an offensive movement against some vital part of the enemy's system. There were two alternatives: the first to strike a blow at the heart of France by an invasion up the Moselle; and the second to seek out and defeat the French army before it could reach Vienna. For various reasons the latter alternative was chosen and Marlborough pushed forward his preparations with equal energy and secrecy.

To preserve secrecy he had hit on an excellent device for deceiving everybody, whether friend or foe. He gave out that he would march to the Moselle. The French would readily believe in it, the Dutch might be induced to consent to it, and if he could establish a depot of stores up the Rhine at Coblenz, he would have accomplished an important stage upon the road to Bavaria. [Taylor's "Wars of Marlborough."]

PREPARATION FOR THE CAMPAIGN.

On May 2, 1704, Marlborough informed the deputies of the States (Holland) of his resolution of marching to the Moselle. The States General agreed that he might march with all the troops in Her Majesty's pay, and with such other of the auxiliaries as could with safety be spared. Marlborough then represented to them the necessity of carrying with him a sufficient Train of Artillery with powder and ball, and other ammunition and instruments requisite for such service. "These were likewise granted him, and his Grace ordered them immediately, to be put into boats, *with Beds, medicaments and other provision for the Hospitals* and made application . . . for the necessary passports for the free passage of the boats up the Rhine . . . to Coblenz" ["Journal of the Duke of Marlborough's Campaigns," by Dr. Francis Hare, British Museum MSS., ADD. 9114].

(N.B.—Many of the references to medical affairs come out of this journal. Dr. Hare, later Bishop of Chichester, was in 1704 Chaplain

General to Marlborough's Forces. The origin of the journal is described in the following extract from a letter from the Duke's secretary, Mr. Cardonnell, to the Secretary of State, Mr. Harley, dated September 25, 1704.

"Sir,

"I have received the honour of your letter of the 29th past, wherein you desire a relation of our campaign under my Lord Duke, in answer to which you may please to be informed that his Grace has committed the care of it to one of our chaplains, an ingenious gentleman: he has the use of my books, and will be very exact in every particular. His Grace takes the pains to peruse it himself, and as soon as we come home it shall be submitted to your correction before it goes to the press." [*"Letters and Dispatches of John Churchill, First Duke of Marlborough,"* by Sir George Murray, vol. i, p. 409.]

In this Journal Dr. Hare refers sometimes to "the hospitals" and more often to "the hospital." It is pretty clear from the context that there was never more than one.)

Marlborough pressed on his preparations.

On May 5, 1704, he writes to MM. le Grand Doyen et Chapitre de la Métropolitaine de Cologne, à Cologne:—

"Messieurs

. Nous sommes . . . obligés de faire monter quelques bateaux avec des munitions de guerre, l'hôpital et autres choses nécessaires pour les troupes, selon le mémoire ci-joint, lesquelles auront besoin de vos passeports, que je vous supplie d'avoir la bonté de leur faire expédier au plus-tôt, comme aussi de leur fournir des escortes avec des chevaux, et de leur donner telle autre assistance qu'ils pourront demander, pour faciliter leur voyage." [*"Marlborough's Dispatches,"* vol. i, p. 255.]

Again, on May 8, 1704, he writes thus to M. Lottum:—

"Monsieur,

M. le Comte de Wratislaw devant passer par Wesel, je suis ravi de l'occasion qu'il m'offre de vous assurer de mes respects, et dois en même temps de vous prier très-instamment d'avoir la bonté de prêter la main à sept bateaux qui montent le Rhin, avec des munitions de guerre, l'hôpital et quelques bagages, pour les troupes Anglaises, que je fais marcher vers la Moselle, et dont l'expédition nous est d'une très-grande conséquence. M. le Baron de Schmettau les aura déjà pourvu des passeports nécessaires." [*"Marlborough's Dispatches,"* vol i, p. 256.]

THE MARCH TO THE DANUBE.

The Duke had given orders to his brother, General Churchill, to assemble the Army at Belburg, which is between Roermond and Cologne. Here Marlborough reviewed them on May 18, and found them to consist of fifty-one battalions and ninety-two squadrons. The English contingent numbered 16,000 men. [Taylor's *"Wars of Marlborough."*]

The march began on May 19, along the road Kerpen-Kühlseggen-Meckenheim, to Sinzig, on the left bank of the Rhine which was reached on May 23. Here the troops had two days' rest, and on May 25 the Duke left accompanied by all the Cavalry and Dragoons, leaving General Churchill to follow as rapidly as possible with the Infantry, Artillery, and baggage.

The route taken led now along the left bank of the Rhine as far as Coblenz, where the river was crossed, and then across country to Kastel, a village on the right bank of the Rhine over against Mainz, which was reached on May 29.

It is clear that the hospital was brought up by water as far as Mainz, for on June 22 Marlborough sent the following letter to the Elector of Mayence:—

" Monseigneur,

J'ai reçu les lettres que votre A. E. m'a fait l'honneur de m'écrire, et lui suis infiniment obligé des soins qu'Elle a bien voulu se donner pour l'acheminement des bateaux avec les munitions et l'hôpital "

[*"Marlborough Dispatches,"* vol. i, p. 324.]

Dr. Hare makes the following note in his journal, dated May 29:—

" And tho' the troops notwithstanding all their fatigue and ill weather had hitherto continued to be very healthy, yet his Grace thought it convenient to order an Hospital to be appointed at this place, as well for these few which were, as for others which might become sick and unable to march." [Dr. Hare's Journal.]

The troops had now made nine marches in eleven days and they deserved two days rest, though it is recorded that they were extremely pleased with the expedition. [Coxe, vol. i, p. 160. Marlborough to Godolphin.]

Out of the rather dry histories of the period it is just possible to catch a note as to the conduct of the British soldier on this march which is strangely reminiscent of that of our men in France during the late war. It seems to have been a sort of triumphal progress: the troops were looked upon as the saviours of the country, and strange to say they had money to spend and paid for what they wanted: no wonder they were welcome and the men were pleased. Can one not picture them playing with the village children in the evening and chaffing the girls in what they pleased to call German (or was it Alleman?). It is noted too that some of the officers found the ladies handsomer than they expected. [R. Pope to Thomas Coke. "*Hist. MSS. Comm.*," 12th Report, Appendix, Part III.]

May 31 saw the troops on the move again on the road to Ladenburg on the River Neckar, which was reached on June 3, when again two days' halt was made not only for rest, but to allow Churchill time to lessen the gap between the horsemen and the main body. From Ladenburg Marlborough wrote to the Dutch Government disclosing his intention of marching to the Danube "for the relief of the Empire," and he begged them to allow their troops "to share in the honour of that expedition."

Leaving Ladenburg on June 6, Marlborough took the road to Heilbron, arriving at Gross Gartach on June 8.

From here he wrote a letter to his brother, which illustrates the care he took of every detail which might affect the comfort, health and efficiency of his men.

"By a letter I have seen from Col. Rowe, he writes that the foot may soon be in want of shoes ; that they are to be had at Francfort at reasonable rates, and that the contractors will send them forward to Nuremberg : therefore I desire you will call the commanding officers together that you may know the number they will want, and thereupon order Col. Rowe to write to Francfort that they may be hastened to Nuremberg, when we can send for them to come forward to us.

I hope this warm weather you take care to march so early as to be in your camp before the heat of the day." [*"Marlborough's Dispatches,"* vol. i p. 301.]

Meanwhile the hospital with the heavy baggage had come up the Rhine as far as Mannheim, presumably having been towed up-stream by horses. Now Marlborough ordered "the commissarys of the hospital to get waggons at Mannheim for his medicaments and provisions and for such stores for the Artillery as might be immediately necessary and to bring them away from thence to Hailbron and to follow with all diligence from thence to Gislingen." [Dr. Hare's Journal.]

On June 9 Marlborough advanced to Mundelsheim, where on the following day he was joined by Prince Eugène, who was closeted alone with the Duke for three hours. [Taylor—quoting Coke MSS. letter of June 13, 1704.]

The next day's march was to Gross Heppach. Eugène accompanied the column and expressed the desire to review the British Cavalry. He expressed his surprise to find them in such excellent condition, after so long and speedy a march. He is reported to have spoken thus :—

"My Lord, I never saw better horses, better cloaths, finer belts and accoutrements ; yet all these may be had for money ; but there is a spirit in the looks of your men, which I never yet saw in any, in my life." [Lédiard, vol i, p. 307.]

How can any who watched our battalions march into action fail to recall that "spirit in the looks" which still animates the face of the British soldier ? At Gross Heppach the two commanders awaited the coming of their ally, Louis of Baden. The result of their consultations there was, that the armies of Marlborough and Louis of Baden should manœuvre together, each general commanding on alternate days, and Prince Eugène was to head a separate army on the Rhine to watch Marshall Tallard. Marlborough appears to have wanted to co-operate with Eugène, but had to give way to the insistence of Louis of Baden.

On June 14, the troops set out on the road to Ebersbach, while Marlborough remained behind to entertain his two colleagues at dinner at

the Lamn Inn, where the tradition of that famous day is still preserved. On June 16 he halted at Gross Sussen, where he continued till June 21. From here he wrote to the Circle of Franconia at Nuremberg, stating that he had ordered a magazine to be established at Nördlingen for provisioning the troops and praying their assistance for the purchase of grain and transport at a reasonable price. ["Marlborough's Dispatches," vol. i, p. 311.] A similar letter was sent on June 19 to the Circle of Suabia informing them of his proposal to establish magazines at Heidenheim and Nördlingen.

It had been raining heavily for several days. The roads were becoming bad, and it is clear that there was some sickness among the troops, and that the Duke was concerned as is shown by this letter dated June 22 to General Churchill :—

"Sir,—I received yesterday yours of the 20th at Blockingen, and having informed myself of the most proper place for sending your sick men, I am assured they will be best at Heidenheim, which is not far from you (about 35 miles), and therefore desire you will forthwith send them thither in carts with an able chirurgeon and a mate or two to look after them, and such commission and non-commission officers as you shall think fit, giving them at the same time money for their subsistence. We have this day joined Prince Louis, and shall not march far till you come up with us, which I pray may be as soon as conveniently you can. The enclosed is the Duke of Wirtemberg's order for your sick to be received in the town of Heidenheim. I long to have you with me, being

"Your loving brother, M."

["Marlborough's Dispatches," vol. i, p. 321.]

There is no hint as to what this sickness was due to. It was not confined however to Marlborough's troops, for on June 19, in a letter to Mons. —, at Zell, Mr. Cardonnel states, "Deserters who come over to our army, report unanimously, that the French battalions are very weak, notwithstanding the recruits they have received ; and that sickness reigns very much among these new-comers, insomuch that 150 have been buried at Ulm in one week. [Lédiard, vol. i, p. 310.]

Again on June 25, Mr. Cardonnel writes :—

"The continual rains, which have fallen for a fortnight passed, have very much incommoded our Infantry, and caused some distempers among them : but we send our sick to Heidenheim, where they soon recover." [Lédiard, vol. i, p. 316.]

On June 21, Marlborough advanced to Ursprung and on the 22nd to Westerstetten where his army joined hands with that of Louis of Baden.

The critical moment for Marlborough was now approaching, and the success or failure of his long flank march was soon to be decided. The Elector of Bavaria, the French Ally, knew that the game had taken a dangerous turn for him, and the fear that Marlborough's goal might lie upon the Danube had kept him back all May and June from marching on

Vienna. In May Louis of Baden had failed to prevent Marshal Tallard from passing a detachment of 10,000 recruits through the Black Forest for Marsin's army which was acting in concert with the Bavarians. Yet in spite of these reinforcements the Elector of Bavaria was disquieted and began to negotiate terms with Marlborough. These however, were too ridiculously high to be considered, and Marlborough with the forces of Louis of Baden pressed on to Donauwörth which was considered to be a point on the Danube of the greatest importance.

The Elector of Bavaria took up a strong entrenched position between Lawingen and Dillingen. Marlborough marched past this camp, leaving it on his right, reaching Amerdingen, 15 miles from Donauwörth, on July 1.

BATTLE OF THE SCHELLENBERG, JULY 2.

The Elector of Bavaria had failed to fortify the hill called the Schellenberg, on which the safety of Donauwörth depended. To repair his mistake he now sent troops, labourers and engineers.

Both Marlborough and Louis of Baden realized that Donauwörth must be taken before the Schellenberg was rendered impregnable. On the evening of July 1 the Duke and his colleague conferred. They must have agreed to attack next day, which was Marlborough's turn to command.

The following extract from Dr. Hare's Journal now shows the first definite account of the establishment of the hospital:—

"And being returned (from Prince Louis's quarters) about 10 at night, he (Marlborough) sent an express to the Commissary of the Hospital to hasten him away to Nordlingen, and to march day and night till he had settled with it there. This express was followed by two more, to hasten the apothecaries and surgeons: his Grace sending them a recommendation, which he had obtained from Prince Louis, to the magistrates and inhabitants of this place for all manner of necessaries." [Dr. Hare's Journal.]

The troops set off before daylight on July 2, and had a fifteen miles' march to Donauwörth over roads ruined by perpetual rains.

The attack on the Schellenberg was made in the late afternoon, and Marlborough won, though he had to pay a high price for the victory.

Over 1,400 of the Allies were killed and nearly 4,000 wounded.

The loss in officers and particularly in officers of high rank was extraordinary. [Taylor's "Wars of Marlborough."]

The English casualties were over 1,500, and exceeded both actually and relatively those of any other contingents engaged.

The actual number of the troops engaged is not stated, but it can be inferred from the fact that when Marlborough drew up the attacking force on the lower slopes of the Schellenberg it consisted of 5,850 foot, supported by 30 battalions and 35 squadrons of horse.

The plight of the wounded must have been bad, for:—

"The moment this action was ended it grew dark and rained violently.

This proved very fatal to the wounded of which we had great numbers. However his Grace ordered them to be dressed with all possible haste, and to be forthwith sent to the Hospitals." [Dr. Hare's Journal.]

Marlborough retired that night to his own quarters at Obermorgen where he received the news of the killed and wounded.

"All his Grace's care was now employed about sending the wounded away to the Hospital. And as there was a particular hand of Providence directed him in all his marches and designs, so it was very remarkable in the happy arrival of the Apothecaries, Surgeons and medicaments at Nördlingen in the time of the action, and they had notice to make their preparations by the noise of the engagement, which was about 12 miles from them." [Dr. Hare's Journal.]

The above appears to be all the available evidence concerning the arrangements made for the treatment of the wounded at this battle.

We know that the Allies had some 4,000 wounded, and that a hospital was established—on the same day as the battle—at Nördlingen, which was twelve miles distant. Also that heavy rain fell the night of the battle. One can infer the rest. Many of the wounded must have died from exposure. One assumes that the survivors were dressed on the field by their regimental surgeons and then transferred to the hospital by slow degrees in country carts which were borrowed from the surrounding farms. It must have taken a long time to clear the field and get those 4,000 wounded to Nördlingen.

And what sort of hospital was there at Nördlingen? We know that the hospital train only arrived there on the day of the battle, and though there is evidence that they took beds with them (see p. 277), there is no mention of tentage. One must presume, therefore, that they did as we often did in France during the late war, and made use of barns, churches, and possibly the town hall.

Nördlingen cannot have been a very large town, and the two following letters from Marlborough appear to indicate that the influx of so many wounded seriously incommoded the inhabitants:—

"To the Bourgmaitres et Sénateurs de Nordling.

"ce 8 Juillet, 1704.

"Messieurs,

"J'ai reçu la lettre que vous m'avez écrite par vos députés qui m'ont expliqué ce que vous souhaitez de notre part. J'ai aussi appris d'ailleurs le soin que la ville a eu de nos blessés, sur quoi je serai toujours fort aise de vous soulager autant qu'il me sera possible: pour cet effet Mm. vos députés sont munis d'un ordre pour le directeur de l'hôpital afin qu'il fasse sortir et mettre dans les villages les plus proches ceux des blessés qui sont dans le meilleur état, ne doutant point que vous n'assistiez ledit directeur en tout ce qui sera nécessaire pour la commodité de ces pauvres gens."

["Marlborough's Dispatches," vol. i, p. 346.]

"To Baron D'Alberg.

"ce 8 Juillet, 1704.

"Monsieur,

"Je vous suis bien obligé de la lettre que vous m'avez écrite au sujet de nos pauvres blessés, et de l'intérêt que vous prenez à leur égard. J'envoie à présent des ordres au directeur des hôpitaux de faire sortir dans les villages voisins ceux qui sont en état de marcher, comme vous le souhaitez, et je ne doute point qu'en cas qu'ils ne seront le moindre degré exposés, que vous n'ayez soin de donner les gardes nécessaires pour leur sûreté."

["Marlborough's Dispatches," vol. i, p. 346.]

Marlborough appears to have had the personal superintendence of much of the details of a quartermaster's work which in modern times would be left to a subordinate, for on July 19 we find him writing to M. Baldwyn asking him to send cattle to the hospital at Nördlingen to be distributed among the sick and wounded in Her Majesty's and the State's pay.

["Marlborough's Dispatches," vol. i, p. 360; and Dr. Hare's Journal.]

To our modern ideas little effective help can have been given to our own wounded, though the fact that there was a hospital with a staff of surgeons was an advance on the absence of arrangements in previous campaigns. What must have been the condition of the enemy wounded who remained in Marlborough's hands! They were probably allowed to lie where they fell, with such attention as could be given them by their comrades, for on July 23, Marlborough wrote to General D'Arco offering to send his wounded which were at Donauwörth if he would return an equal number ["Marlborough's Dispatches," vol. i, p. 368], and on August 6 he writes again to General D'Arco, saying that his wounded can leave if he will send the necessary transport, and also that if he wishes to send surgeons they would receive the necessary passports. ["Marlborough's Dispatches," vol. i, p. 385.]

NARRATIVE OF EVENTS BETWEEN THE BATTLES OF THE SCHELLENBERG AND OF BLENHEIM, AUGUST 13.

The Elector of Bavaria and Marshal Marsin abandoned their strong position at Dillingen immediately after the battle of the Schellenberg, and entrenched themselves behind the River Lech protected by the guns of Augsburg, where they could await without fear of attack the coming of Marshall Tallard and his army.

Marlborough's first objective was now obtained. He had succeeded in interposing his army between the invading enemy armies and Vienna, and the Empire was saved.

His strategy now was to defeat the enemy in the field, but as for a time he was unable to do this he adopted the other alternative, that of laying waste the country and practically starving him out.

The next great move in the game was the advent of Marshal Tallard with his army which joined the Bavarians and Marzin on the River Lech, on August 4. Prince Eugène with his small army had only shadowed them.

The French and Bavarian army now left their strong position under Augsburg and moved westward, threatening Marlborough's line of communication of Nördlingen.

Marlborough replied by a rapid westward concentration of his force with that of Prince Eugène at Münster. A decisive engagement was essential. He sought it, and on August 13 the battle of Blenheim was fought.

Battle of Blenheim.

The details of this battle have been set forth in various books. It is not the intention in this paper to do more than indicate such points as are necessary to understand the arrangements made for the wounded.

The allied forces were in motion by 2 a.m., and, aided by a thick white mist, took up their position on the left bank of the River Nebel almost undetected by the French.

The French artillery opened fire between 8 and 9 a.m., to which the Allies replied as best they could with their fifty-two pieces. There was an awkward and anxious pause until Eugène could get his forces into position.

According to Dr. Hare, Marlborough now ordered the chaplains to hold a service at the head of each regiment and after this act of devotion he pointed out to the surgeons the proper posts for the care of the wounded. Taylor in his "Wars of Marlborough," says: "he instructed the surgeons as to the proper stations for the field-hospitals" [vol. i, p. 211]. He does not give any authority for the establishment of "field hospitals," and as it would appear that he got what information he has on medical matters from Dr. Hare's Journal, it would seem probable that the arrangements Marlborough really made were the formation of collecting posts or regimental aid posts where possibly two or three regimental surgeons may have joined together to render first aid to their wounded.

The facilities for any operative treatment were probably *nil*, or otherwise the following extract would never have been penned:—

Lt.-Col. Philip Dormer of the English Guards, and described as the flower of the army . . . "was wounded in the left thigh about 3 in the afternoon by a muskett ball which broke his great artery and expired in the Author's arms a little after six." [Dr. Hare's Journal.]

The battle was over before night and one of the world's great victories won.

Tidings of victory were on their way home. Colonel Parke, Marlborough's A.D.C., had started on his eight days' ride taking to the Duchess a short dispatch scribbled with a lead pencil on a scrap of paper.

After the battle the Duke ordered that the soldiers should lie all night upon their arms, in the field of battle. . . . "After this his Grace

gave orders about dressing the wounded men and putting them under cover." [Dr. Hare's Journal.]

The following extract from Dr. Hare's Journal is the authority for what happened the day after the battle: "And now his Grace took an especial care to have all the wounded men sent to the hospital. For this purpose he orders all the country round about him to bring in waggons and carriages upon pain of military execution and the serjeants of all the regiments were commanded to take up and send away their own men."

Forces Engaged.—The Allied Army was 52,000 strong, 34,000 being under the command of Marlborough and 18,000 under Prince Eugène. The French army outnumbered that of the Allies by about 4,000 men. [Taylor's "Wars of Marlborough."]

Casualties.—The Allies' Casualty List was: killed, 4,485; wounded, 7,525; missing or prisoners, 273. [Lédiard, vol. i, p. 397.]

The exact losses of the enemy were never ascertained. They are computed to have been at least 14,000, killed, wounded or drowned, and 15,000 prisoners. [Taylor's "Wars of Marlborough."]

If the resources of the hospital at Nördlingen were strained after the battle of the Schellenberg, how much more so must they have been after Blenheim with over 7,000 wounded to be cared for. One can suppose, however, that the surgeons had had time to find houses and accommodation for the wounded they must have realized would sooner or later descend on them like a flood. One would like to find some account of how the surgeons worked and what they did.

At least we know their names owing to the fact that a list known as "The Bounty Roll" was prepared by order of the Duke of Marlborough for the application of the Royal Bounty that Queen Anne was pleased to bestow on the officers and men of the regiments that were in Germany [Chas. Dalton, "English Army Lists."]

The following is the list of surgeons on the staff of the Hospital at Nördlingen:—

Thomas Wilson. He died later of barbarous usage he received from the enemy in Flanders in 1711. His widow received a special pension of £30.

Claudius Amyand. Was the son of a Huguenot refugee. In 1728 he was admitted to the freedom of the Barber Surgeons Company. He became a Fellow of the Royal Society and Serjeant-Surgeon to George II. He was surgeon to St. George's Hospital 1733-1738. He died in 1740 following an accident in Greenwich Park. ["Annals of the Barber-Surgeons of London": Sidney Young.]

John Goldie. In 1704 appointed Surgeon to Colonel Godfrey's Regiment of Foot.

Robert Roddam.

Andrew Grierson.

Robert Lee.

William Neilson. On March 1, 1709, he was appointed Director of Hospitals for the service of the British Forces in Portugal.

John Gibson. On April 12, 1706, he was appointed Surgeon to Sir R. Bradshaigh's Regiment of Foot.

William Geneste. Subsequently he served in Spain and was taken prisoner with General Stanhope's troops at Brihuega in December, 1710. On August 25, 1712, was still a prisoner in Spain.

Apparently the two first surgeons on this list, namely, Thomas Wilson and Claudius Amyand, were the senior officers, for not only do they appear first but they each received £30 bounty money, whereas the remaining surgeons received £15 each.

Treatment of the Wounded.—There is scarcely any information as to how the wounded were treated. There were of course no anæsthetics in those days, though opiates were used to dull sensibility during an operation. One may presume that the surgery consisted largely of dressing the wounds with various medicaments, probing them and removing foreign bodies, incising abscesses and amputating shattered limbs. That amputations were done is proved by a letter written by Captain Windham of Lieutenant-General Wyndham's Regiment of Horse to his mother, headed:—

“Nördlingen, August 23, o.s. 1704:

“I was loth to write very soon after the first account I gave you of my being shot in the leg in the late engagement, because truly my surgeons could not tell what to think of the matter; but upon my arrival at this place—which is the hospital for all our wounded—I have got all the help I can desire, and on Tuesday last was a fortnight my leg was doomed to be cut off, and accordingly was that day, since which time I thank God there has not happened the least ill accident there could be . . . surely a greater victory was never gained. They were 11,000 foot stronger and we were 5,000 stronger in horse. They were so strongly encamped that they laughed to see us coming.”

In spite of the loss of his leg Captain Windham continued in service and took part in the battles of Ramillies and Malplaquet. [Chas. Dalton “English Army Lists.”]

Thirty-five other surgeons were mentioned by name in the Blenheim Bounty Roll, chiefly regimental medical officers. Of these the surgeons to cavalry regiments received £18 Bounty, those to foot regiments £12, and surgeons' mates £7 10s.

There was only one medical officer killed at Blenheim, and his name was Jno. Whitfield, who was surgeon to the Earl of Derby's Regiment of Foot. His widow received £24 Bounty.

Events after the Battle of Blenheim.

The results of the victory of Blenheim were immediate and striking. The French abandoned Bavaria, retired across the Rhine, and the safety

of the coalition was assured. Marlborough now wanted to make for the Moselle, always harking back to his idea of a thrust at the heart of France. His plans, however, did not find favour in the eyes of his colleagues, and the Allied Armies laid siege to Landau, a puny effort compared with Marlborough's own plan.

Meanwhile the wounded were not forgotten, for Dr. Hare writes on September 13:—

“His Grace still looked backwards with a compassionate eye towards the sick and wounded men that he had left behind him; and sent to know from the Commissary of the Hospital at Nördlingen what number of them were in a condition to be removed, requiring him to get waggons enough to carry them to Mayence and from thence down the Rhine to their respective garrisons and that medicaments and attendants should be lost (? left) with those which could not be brought away without danger.

“Here notice ought to be taken of the pious and charitable care that the City of Nuremburg had towards our sick and wounded men. They made a liberal collection among themselves for their relief, as also a provision of linnen and other necessities which they sent by Commissioners of their own, to be distributed among them in the hospital at Nördlingen, where also the extraordinary care of the inhabitants of that place, as well as from our own Commissary, Physicians and Surgeons ought to be mentioned to their just praise.” [Dr. Hare's Journal.]

Confirming the statement made by Dr. Hare that the wounded were to be transported to Holland by water, we find a letter from Marlborough to the Elector of Mayence, dated September 21, saying that he need not be anxious lest the wounded coming from Nördlingen should be a charge on him, for they would only stop at Mayence just to change boats. He also assured the Elector that he would be relieved of the majority of the sick which remained at Kastel and Kostheim. [“Marlborough's Dispatches,” vol. i, p. 479.]

The final reference to the wounded of this campaign is a letter from Marlborough to the Magistrates of Nördlingen, dated October 22, 1704, in which he thanks them for their hospitality to the poor sick and wounded during the past summer. [“Marlborough's Dispatches,” vol. i, p. 515.]

THE CONVALESCENT DEPOT AS A PERMANENT PEACE ORGANIZATION.

(Continued).

BY MAJOR G. R. PAINTON.

Royal Army Medical Corps.

THE previous memorandum on this subject written in March, 1921, was an hypothesis, a theorem we had set out to demonstrate. We believed it possible to prove that an establishment of this kind would be of such benefit to the Army in Egypt as to justify its continued existence.

Facts will speak for themselves.

First let us look at the total number of cases that have been through the depot, from January to October, 1921. The latter date is taken as marking the end of the summer wave of endemic illnesses.

(1) Total admissions: Seventy-eight officers, 2,047 other ranks.

1a. (By units). The 19th Brigade Royal Field Artillery (from Mesopotamia now at Ismailia) head the list with a total of 257 (all ranks), this being 12·09 per cent of the whole admissions.

The 2nd Battalion Royal Ulster Rifles (from Mesopotamia now at Citadel, Cairo), comes second with a total of 245 (all ranks), this being 11·53 per cent of the whole admissions.

The third place is held by the 2nd Battalion the King's Regiment with a total of 192 (all ranks), this being 9·04 per cent of the whole admissions.

1b. (By Diseases). Malaria leads with 352, or 16·56 per cent of the whole admissions. Following in close order comes P.U.O. with 303 admissions (14·26 per cent), digestive system with 192 admissions (9·04 per cent), and tonsillitis with 186 admissions (8·74 per cent). There is also a prevalence of diseases of the respiratory system and diarrhoea, as witness 108 admissions of the former and 104 admissions of the latter.

Regarding *Malaria*. The highest individual admissions by units were as follows:—

Royal Irish Fusiliers	57
Royal Field Artillery	38
Royal Army Service Corps	33
Royal Ulster Rifles	32
Royal Engineers	29

The number of cases of malaria transferred to other hospitals was seven ty, of which sixty-two were sent to the Military Hospital at Ras-el-

290 *Convalescent Depot as a Permanent Peace Organization*

Tin. Malaria heads the list of transfers to other hospitals owing to relapses.

Heat-stroke was not prevalent, a total of twelve cases being admitted.

Dysentery.—The highest number of cases admitted was eleven from the Royal Field Artillery, i.e., 15·94 per cent out of sixty-nine total admissions.

Bilharziosis.—The 2nd Battalion Royal Ulster Rifles provided the highest number of cases. That regiment has sent us sixty-one cases or 79·22 per cent. The only other cases occurred amongst the Royal Field Artillery, who sent us sixteen cases or 20·78 per cent. Both these units were infected in Mesopotamia.

Venereal Disease.—Seventeen cases have been transferred to the 17th General Hospital.

The highest number of diseases occurring amongst the Royal Air Force was twenty-six diseases of the digestive system. There have also been eight cases of malaria and four of dysentery from that force.

The average stay of patients treated was kept religiously to three weeks and this rule was not altered except:—

(a) In cases where the patient was not fit to return to duty.

(b) Invalids awaiting passage to the United Kingdom.

(c) One non-commissioned officer kept in for two months during the hot weather. He was found an invaluable assistant to the establishment as an instructor in graduated training and games. His tact and cheerful character helped also in many other ways.

(d) Cases awaiting trial by Field General Court Martial.

No other exceptions were made to the three weeks rule no matter what pressure or persuasion or advice was brought to bear in the hopes of some relaxation.

I give Captain Burton's report on the reaction of certain typical groups of these cases to recreational training and sea-bathing, etc.

REPORT ON THE REACTION OF CONVALESCENT CASES TO GRADUATED RECREATIONAL TRAINING AND SEA-BATHING. JANUARY TO SEPTEMBER 30, 1921.

“(1) *General*.—The scheme of recreational training as laid down in the previous report on the convalescent depot, had of necessity to be modified as one gained experience.

“The grouping of games into two main groups ‘A’ and ‘B’ was maintained throughout, but it was found impracticable to confine groups to specific categories or sections.

“The system of categorizing patients and of placing them in sections

was mainly of use in administration. The routine of training gradually developed into a selection of patients for the game group for which they were best fitted, medically or by adaptability, regardless of category, thus it often happened that a patient on transfer after a few days' rest, volunteered and was fitted for 'B' game group, which included the more strenuous games normally intended for the last week of convalescence. In the great majority of cases it was found advisable to order two to three days' 'excused games' on transfer, after which, whatever the category, the patient was placed in one of the games groups. 'A' categories were obliged to start in 'A' group and progress, but many cases were marked 'B' for games after their short rest.

"Again, the monthly inter-company competitions necessitated modification in the original scheme.

"The competition comprised games of varying physical severity and to obtain the maximum result at least fourteen days' training was required for the different events, and as the stay of the convalescent was confined to twenty-one days, it followed that competitors began to train for their particular event within the first week after their transfer and were excused the routine group games, which were played by those convalescents who did not volunteer or were not selected for the competitions.

"All competitors were reviewed by the medical officer before being allowed to train for the competitions, to exclude, among others, those men with "large hearts," both figuratively and literally.

"The two to three days' rest after transfer was found by experience to be beneficial, it allowed the patient to adapt himself to his surroundings, and it allowed a new arrival to watch the types of games he would be expected to play and so to select his *métier*. During the period of rest the average patient was encouraged to sea-bathe and take walking exercise and so as a general rule a man began his games more or less acclimatized.

"Sea-bathing from April onwards became a part of the compulsory routine training and water events were included in the company competitions.

"The usual morning routine for intending competitors was one and a half hours' training for the special event, followed by sea-bathing, and for the non-competitors one and a half hour's group games, after which they were allowed to cool and then marched down to the sea.

"In very exceptional cases, sea-bathing was forbidden, usually because of some pathological cardiac lesion.

"The following classification is only given to show the general reaction of certain classes of cases. Of the cases returned to hospital for further treatment, those in the respiratory, intestinal and malarial groups were most common.

292 *Convalescent Depot as a Permanent Peace Organization*

“(2) *Classification of Certain Groups of Cases and their Reaction to Training* :—

	Classification of cases	Reaction to treatment
1	Respiratory	Generally poor, especially in cases of bronchitis, probably due to dampness of atmosphere. Best results obtained in pneumonias.
2	Cardiac, primary ..	Very few cases. Heart condition did not alter appreciably. General condition reacted well.
3	Cardiac, secondary ..	Reaction good. Both cardiac and general muscular tone improved. Distinct alteration in pulse rate noted. Apex beat in many cases definitely altered to normal.
4	Intestinal	Tendency to recurrence in diarrhoea, probably due to sand during windy weather which has been very persistent.
5	Nervous neurasthenia ..	Neurasthenia reacted well, due chiefly to complete change of duties and surroundings.
6	Anæmia, primary ..	One case only, marked favourable reaction.
7	Anæmia, secondary ..	Satisfactory reaction.
8	Malaria	Good in those cases with less than three relapses. Poor in the malarial seasons in other cases. General condition much improved.
9	Other pyrexias	Good.
10	Bilharziosis	Very good. Put on weight with no return of symptoms.
11	Tonsillitis	Fair. Tendency to recurrence. Closely associated with cardiac secondary.
12	Surgical, post-operative	Good, especially in appendicectomy. Muscular tone improved.
13	Surgical, joint cases ..	In cases of synovitis bad. No opportunity for scientific massage.
14	Surgical, fractures ..	Generally good. Movements reacted well.
15	Surgical, I.A.T.	Good, but healed slowly. Chiefly due to injury in games and infection from sand.

“(3) *Summary*.—It will be seen that reaction to training could only be estimated on very broad lines and not scientifically.

“The small staff and limited time did not allow of a careful judgment on each individual case, but the conclusions formed are based on a series of forty selected cases which were carefully examined on transfer and watched throughout their convalescence and recorded.

“The neurasthenic element played an important part in the progress of certain types, as it was only after the continued performance of group games, that some cases could be persuaded to believe that they were not suffering from incurable heart disease.”

During these ten months, six invalids who had been approved for invaliding to the United Kingdom, but whose embarkation was delayed, were returned to duty as fit by the Assistant Director of Medical Services of Egypt who originally approved their invaliding. To this fact may be added that many who were at one time or other borderline cases for invaliding returned to duty fit, and only one case (emphysema of lung) was invalided from the depot during the year. There were other cases of continually recurring malarias who were transferred to hospital as recom-

mended for invaliding but these were sent back to the depot by the hospital authorities who thought that a further convalescent period would see them fit for duty. In nearly all these, the hospital authorities were correct and eventually these cases returned to duty almost, if not completely, re-established in health.

Another fact of which there is no doubt whatever, and which was commented on by officers in the battalions to which the men returned, was the obvious outward appearance of benefit in health which the troops had when they rejoined their units. To put it in the words of the officer in medical charge of troops at Abbassia who saw the men on their return at his inspection room, "I can almost tell from their appearance the men who have just returned from Sidi-Bishr," or a senior officer's remark about some of the cases coming back to his company, "I thought I would never see some of these men again when they went to hospital and now they are apparently as fit as ever."

These recoveries are due primarily to the healthiness of the site and sea-bathing, but almost equally to the exercises and games which were carried on all through the year with a three weekly inter-company competition, and also to the excellent food and cooking.

Great praise is due to the kitchen staff who felt proud of their management. During the busiest six weeks of the year they catered and cooked for a turnover of over 2,000 men. I have heard nothing but praise about the food and cooking during the year.

On the occasion of one of the inter-company competitions the staff and convalescent officers asked if they might be "At Home" for the day, and Major General Sir Foster Newland and Colonel Commandant Blake, General Officer Commanding Alexandria, and other Staff Officers from General Headquarters Egyptian Expeditionary Force had an opportunity of feeling the spirit of competition which existed between "A" and "B" convalescent companies.

It was impossible to employ any ergometer tests of fitness. Had these been taken there would have been a marked difference noticed between the divergence of the CO₂ curves when comparing the first and third week patients. Men arrived 20 to 50 per cent fit and left here 75 to 100 per cent fit.

So much for the patients, but how about the staff? Well, the small staff allowed, never increased, and often depleted by admission to hospital and other causes, struggled gamely on, and were often more ill and often more tired looking than the patients themselves. All of them worked very hard and were at one time snowed under; all of them are proud of the work they have done; most of them have enjoyed their work in some way; and most if not all of them say they would prefer an easier job next year.

I know my brother officers are with me when I say that if we have failed—and we have failed—to achieve anything approaching an ideal, we

294 *Convalescent Depot as a Permanent Peace Organization*

have failed because the staff has been too small and not trained to this kind of work, and without specialists such as physical training instructors, masseurs, etc.

We have refused steadfastly to increase our establishment by holding back helpful patients.

In order to make a convalescent depot a real success it is essential to have a few good regimental non-commissioned officers, attached more or less permanently.

It is impossible for the average young non-commissioned officer of our Corps to have the same power of control over a hotch-potch of non-commissioned officers and men drawn from every regiment and corps, and changing every three weeks and counting among them the most troublesome characters in their units—as their own non-commissioned officers exercise in those units.

It must be remembered :—

(1) That the patients are not ill enough to prevent their getting about almost as freely as when in full health.

(2) That their dress is not distinctive as in a hospital.

(3) That they draw their full regimental pay.

A convalescent depot of 500 beds should have a trained masseur, two additional Royal Army Medical Corps serjeants who have qualified as physical training experts, one serjeant cook and a steward. All of these have been sorely missed.

The clerical work, index cards, statistics, disciplinary clerical work and the clerical work of the quartermaster's department, absorbed most of the available permanent staff. The clerical staff was knocked up more than any other department, through working continuously in the hot hours of the day.

The remarks on the staff lead directly to the question of discipline. When the numbers are about 200, discipline is good. Supervision is equal to the task. Above 200 men, there is a sudden change; and this was particularly noticeable during the four hot months of the year. During that period there were 7 courts martial, 16 convictions for drunkenness and 35 absent without leave. This was to a certain extent due to the fact that the 19th Brigade Royal Field Artillery and the 2nd Battalion the Royal Ulster Rifles and the 1st Battalion the Royal Irish Fusiliers had recently come from Mesopotamia and were in a poor state of health and unsettled mentally.

When the state of discipline of the troops was at its lowest in the Depot the one thing that never failed to improve the situation, and on one occasion to eliminate all crime for nearly two weeks, was an appeal to the assembled companies to play the game by those who were doing their best for them.

The men's hearts are as good as of yore but their heads are badly confused.

One source of much trouble was found to lie in the fact that one of our non-commissioned officers had temporarily lost his sense of humour and had tried to get "his own back" on men who were certainly very difficult to deal with. Great patience is required from the staff when a fresh batch of young bloods arrives every three weeks to be nursed back into health and their misdemeanours tackled.

As regards the cost of a convalescent depot, we were assessed by the accounting staff for the first time in April, 1921; the following figures are for the month of August, by which date an accurate cost of working expenses was obtained:—

The total number of diets drawn during this month was 10,568			
Supplies for the month	cost	per head	per day 2s. 7·963d.
Medicines and drugs	"	"	" 0·230d.
Military labour (officers and other ranks)	"	"	" 1s. 0·876d.
Civilian's labour	"	"	" 3·185d.

The total working cost under all headings was 4s. 8·916d. per head per day for the month of August, 1921.

This ratio cost per head is less or more as the total number of patients treated rises or falls, respectively.

The schedule rate allowed for a hospital is 12s. per day. A battalion is not costed and no comparison can be drawn, even if this comparison were a safe one.

Travelling expenses by rail are not included in the cost accounting of this unit. This item is charged against the unit to which the patient belongs.

In conclusion, one hesitates to summarize one's opinion, but in all probability a bias will be detected running through this memorandum in favour of the adoption of convalescent depots as peace-time institutions administered by officers of the Royal Army Medical Corps.

The soldiers' physical fitness whether it be twenty or 100 per cent is as much the responsibility of the medical officer as his standard fitness on enlistment and his condition on discharge.

A convalescent depot caters for the soldier in a low state of physical fitness. The regimental physical training instructor takes him on in the higher percentages.

There should be no gap between the two into which these 2,000 odd of all ranks must of necessity fall.

Clinical and other Notes.

OBSERVATIONS ON AGGLUTININ RESPONSE FOLLOWING INOCULATION OF A MIXED VACCINE, CONSISTING OF *B. TYPHOSUS*, *B. PARATYPHOSUS* A, *B. PARATYPHOSUS* B, AND *B. PARATYPHOSUS* C.

BY MAJOR J. A. MANIFOLD.

Royal Army Medical Corps.

AND

CAPTAIN W. W. PRATT.

Royal Army Medical Corps.

IN various areas during the war, a bacillus was isolated from the blood, urine and faeces of cases of an infectious disease, clinically resembling paratyphoid fever. This organism yielded similar biochemical reactions to *Bacillus paratyphosus* A and B, but further investigation by serological methods, proved that it was of a different antigenic structure to these organisms. It is now classified as a fourth member of the enteric group of bacilli and has received the designation of *B. paratyphosus* C.

Cases have been reported from India, Armenia, Albania, Serbia, Macedonia, Mesopotamia and East Africa. The organism has also been isolated from a few cases occurring in this country, and a bacillus which was recovered from a case of suppurative arthritis in a child, and submitted recently to Lieutenant-Colonel Marrian Perry, has been identified by him as *B. paratyphosus* C.

The distribution is thus world wide, and it is probable that the incidence of infection in many areas during the war, would have been higher, if closer serological investigation had been applied to atypical organisms of the paratyphoid B group.

The occurrence of a series of cases of paratyphoid C in Constantinople caused the Army Pathology Advisory Committee to consider the advisability of adding *B. paratyphosus* C to the T.A.B. vaccine.

A vaccine including *B. paratyphosus* C in addition to the other enteric group organisms constituting T.A.B. vaccine was accordingly prepared, the composition being as follows :—

<i>B. typhosus</i>	1,000	} millions per c.c.
<i>B. paratyphosus</i> "A" ..	..	..	..	750
<i>B. paratyphosus</i> "B" ..	..	..	..	750
<i>B. paratyphosus</i> "C" ..	..	..	..	750

The strains of *B. typhosus*, *B. paratyphosus* A, and *B. paratyphosus* B, were those used in the ordinary T.A.B. vaccine. The strain of *B. paratyphosus* C was one recently isolated from a case in Macedonia.

At the suggestion of the Professor of Pathology, Royal Army Medical College, a few experiments were undertaken to ascertain the agglutinin response in men and animals inoculated with the vaccine.

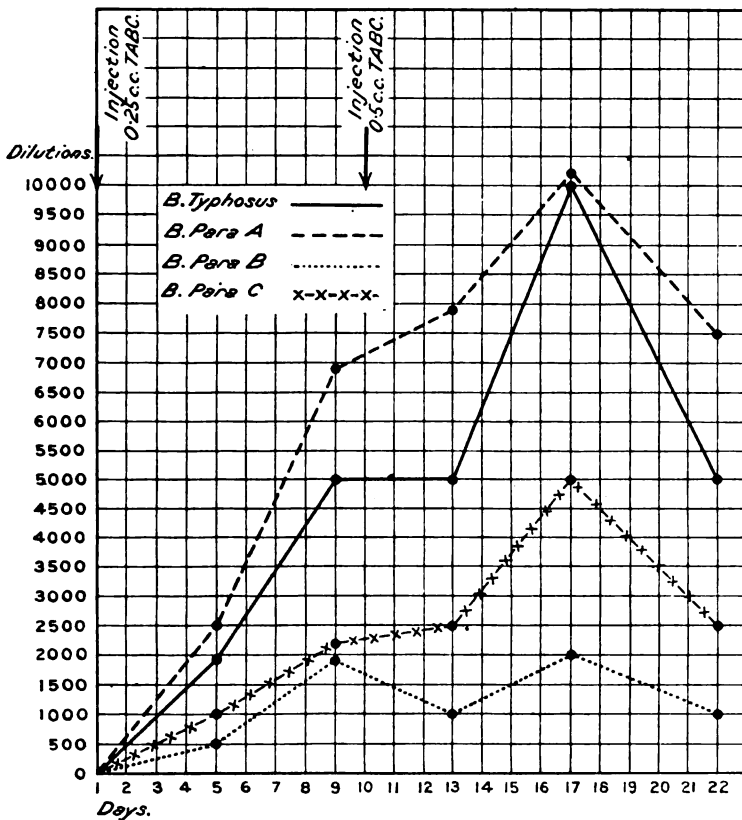
Animal Inoculations.—Two rabbits "A" and "B" were inoculated intra-

venously with 0.25 cubic centimetre, and 0.5 cubic centimetre T.A.B. C. vaccine; the intervals between the doses being ten and twelve days respectively. Graphs demonstrating the agglutinin response are attached.

In both cases the response to *B. paratyphosus* C was marked; the end point of agglutination for that organism was reached at a dilution of 1 in 2,500 in both cases.

The agglutination response to *B. paratyphosus* A is more marked than usual and that to *B. paratyphosus* B unusually low.

The variation in degree of response between the two animals is probably explained on the basis of the individual factor, rather than the difference in the spacing of the doses.



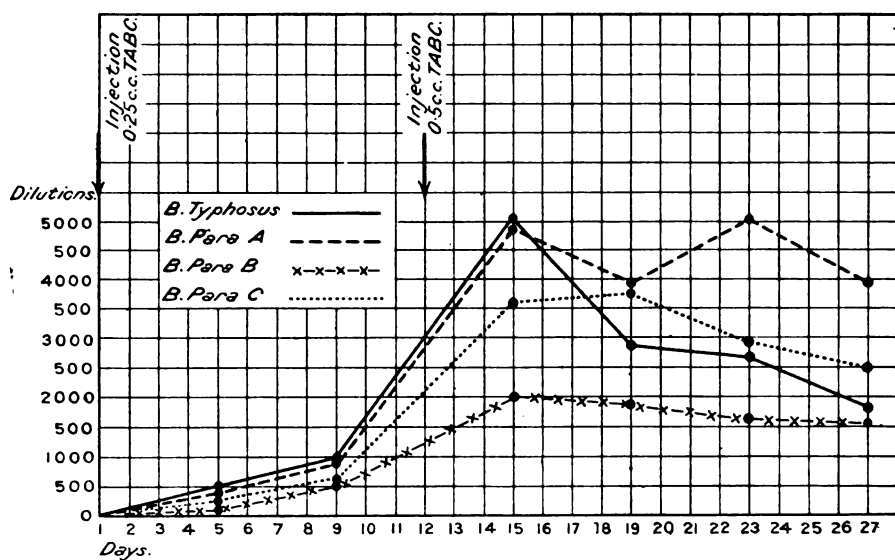
GRAPH A.

Human Inoculations.—Two men were inoculated with 0.25 cubic centimetre, 0.5 cubic centimetre and 1 cubic centimetre of the T.A.B. C. vaccine at seven day intervals.

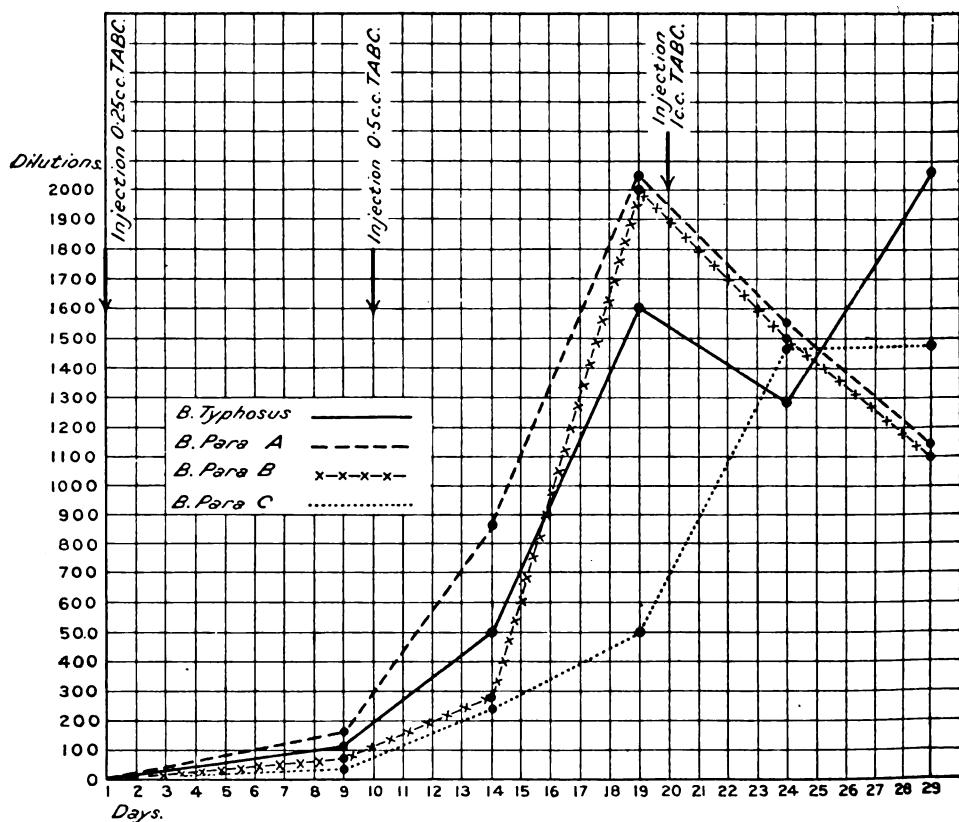
Graphs demonstrating the agglutinin response are attached.

Pte. McE. had not been previously inoculated.

Pte. B. had received two doses of T.A.B. vaccine two years previously.



GRAPH B.

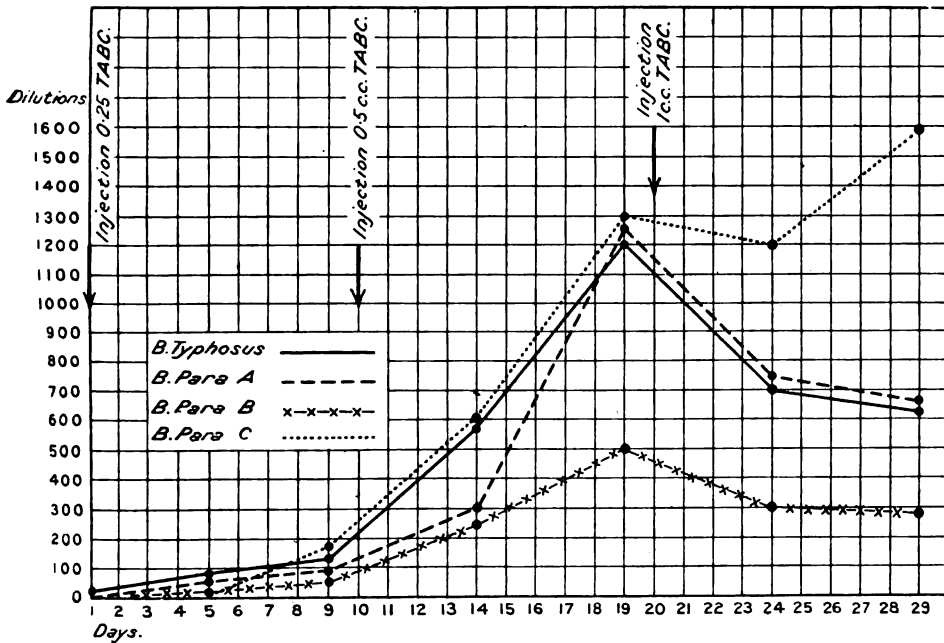


GRAPH C.

In both cases the first dose produced a very slight reaction. The second inoculation caused slight headache and malaise, which passed off in twelve hours and local reaction was slight. The third caused even less reaction than the previous dose.

In both cases the response to *B. paratyphosus* C was marked, and approximately the same.

The difference in response to *B. typhosus*, *B. paratyphosus* A and *B. paratyphosus* B, in the case of the two men is somewhat striking.



GRAPH D.

In the case of the previously uninoculated Pte. McE., the response to all four antigens was well marked, the final end point of agglutination in each case being high.

In the previously inoculated Pte. B., the response to the T.A.B. antigens is much lower than in the case of the "C" antigen.

CLINICAL NOTES ON A CASE OF SPORADIC NON-IMPORTED BILHARZIA HÆMATOBIA CONTRACTED IN BOLARUM, HYDERABAD (DECCAN).

BY CAPTAIN SIDNEY SMITH.

Royal Army Medical Corps.

Gnr. H., a British soldier, was admitted into the British Station Hospital, Secunderabad, on August 25, 1921, for the treatment of an attack of diarrhœa with abdominal pain, which was very prevalent in the station at the time. The stools were sent down to the brigade laboratory for the ordinary examination for *Entamœba histolytica*, and it was with some surprise that a report was received back stating that the terminal-spined ova of *Bilharzia hæmatobia* had been found in the specimen. The man had shown no clinical signs of schistosomiasis, and as it is extremely rarely that one finds the terminal-spined type of bilharzia ova in the fæces, one was somewhat sceptical as to the accuracy of the finding. The following morning separated specimens of urine and fæces were sent down for further investigation. Numerous terminal-spined ova were found in the urine, but none in the fæces. On two subsequent occasions the ova were found in the urine, but never again in the fæces, although carefully searched for in the latter, and the conclusion was arrived at that on the first occasion a mixed specimen containing urine and fæces in an ordinary bedpan had been sent down, thus accounting for the apparent anomaly. It should be noted that the finding of the bilharzia ova was entirely fortuitous, as the man had never exhibited any symptoms of the disease, nor was blood or pus ever present in the urine in even microscopic proportions.

Interrogation of the patient elicited the following suggestive history.

In the first place he had never, before arriving in India, served in any part of the world where any form of bilharzia is endemic. In fact, he had come straight to India with his unit fourteen months previously, and before that had never left England.

He volunteered the statement that from August to September, 1920, he had been in the habit of taking lonely walks to one or other of two small tanks in the vicinity of Bolaram and of bathing in them; during this period he had suffered off and on from an irritating rash of the thighs and abdomen which waxed and waned, appearing most intense and irritating a few days after bathing; during these months, also, he frequently suffered from attacks of vomiting, but had not, as far as he knew, had fever. Immediately the diagnosis was reasonably established on the second day after admission intravenous injections of tartar-emetie dissolved in normal saline were commenced, a line of treatment advocated by most recent authorities. Christopherson recommends an initial dose of half a grain, increasing this on alternate days by half a grain until a maximum single dose of two grains has been reached, and continuing with this until a total of thirty grains of the drug has been given.

Unfortunately the patient showed a definite idiosyncrasy to the drug right from the start, complaining of headache, and vomiting for several hours after the injection. With a view to combating these unpleasant symptoms, the interval between doses was increased to two days, and he was prepared exactly as for an

operation. A purgative was given the night previously, the injection was given three to four hours after a light meal, and three minims of iodine in a drachm of water were administered half an hour beforehand. As a result of these precautionary measures, and possibly also owing to acquired tolerance, he is now able to stand two grains of the drug without any discomfort beyond slight nausea and an attack of coughing immediately the needle is withdrawn from his arm.

The apparent success of the tartar emetic was immediate. After the first injection only a few "ghost" ova were seen, and since then none have been found, although the urine is examined daily.

During the whole course of his stay in hospital to the present the patient has run a slight evening temperature of 99°F., but beyond this he has been quite well and is up and about the ward, only taking to bed on the day of his injections.

In discussing the ætiology of the case many points of interest arise.

In the first place, granting that the microscopical findings were correct, we must accept the case as being one of primary infection, as far as this patient is concerned, in a district and even in a country where the disease in an endemic form is almost unknown. For this to be possible an intermediate host must exist in the vicinity.

The normal intermediate host for this particular variety of bilharzia as it exists in Egypt and elsewhere is the fresh-water snail of the genus *Bullinus*, the cercariæ of the disease having been found in *Bullinus contortus* Michaud, *B. dybowskii* Fischer, *B. innesi* Bouguignat, *B. alexandrina*, to which, according to some authors, may be added *Planorbis mareoticus*, *P. pfeifferi*, *Physopsis africana* [1].

The literature concerning schistosomiasis, as far as it concerns India, appears to be scanty and mostly deals with the possibility of infecting the indigenous population from the large number of native troops returned from Egypt during the war, many of whom undoubtedly suffered from one or other variety of bilharzia contracted in that country.

Samples of fresh-water snails were collected in various parts of the Indian continent with a view to determining if the known intermediate hosts of the disease existed. These investigations appear to have been carried out chiefly at Bombay [2], Calcutta [3], and Secunderabad [4]. No specimens of *Bullinus* or other known intermediate host of *Bilharzia hæmatobia* were found.

Kemp and Gravely, writing on the possible spread of schistosomiasis in India, state that "none of the species of snails which have heretofore been cited as intermediate hosts for the schistosomes of man have been found in India and it is improbable that any will henceforth be discovered, nevertheless there is no reason to discredit the idea that a potential intermediary may exist. Over a hundred men suffering from schistosomiasis were living in the vicinity of Hyderabad (Deccan) in 1918. These men had contracted the urinary type of the disease during service in Egypt. Attempts were made to infect fresh-water snails from the neighbourhood of Hyderabad and Secunderabad. The results were entirely negative—no cercariæ corresponding to the larva of any of the human parasite were found in naturally infected snails, a peculiar furcocercous cercaria occurred in *Melania tuberculata* at Trimulgherry. This form did not appear to belong either to the genus or family of bilharzia" [6].

The interest from the above-quoted article lies firstly in the fact that a very complete investigation into the varieties of fresh-water snails and the possibilities

of their acting as potential reservoirs of the disease was undertaken in the very district where the patient under discussion contracted his illness (Bolarum lies in the state of Hyderabad only a few miles from the city of that name). It is separated from Secunderabad by about four miles, with Trimulgherry lying between); secondly, that there actually existed near Hyderabad (i.e., in a war hospital at Bolarum), some three years previously, a camp of 100 men suffering from vesical bilharzial disease, which they had contracted in Egypt.

In view of the fact that all efforts to find any of the normal accepted intermediate hosts of *B. hæmatobia* in the neighbourhood of Bolarum have failed, another suitable host, probably an as yet unsuspected variety of fresh-water snail, though possibly some other small denizen of the neighbouring tanks, must be sought for.

In this respect Cort [7] states that "further studies on the intermediate hosts of the human schistosomes will undoubtedly add to the list of snails which can be utilized as intermediate hosts by these species."

In the case under review the auguries appear to be extremely favourable for the finding of an intermediate host either recognized or unrecognized hitherto, in all probability the latter.

The patient denies having visited more than two tanks, each of very moderate dimensions, the fauna of which should yield to a very moderate survey. The one stumbling-block may be of course the length of time since the disease was introduced, presumably by the 100 returned cases from Egypt, nearly three years ago. We can assume, however, that the cercariæ of bilharzia were flourishing in one or both of the tanks some eight months ago, and it is at least possible that they may still exist. As far as I have been able to gather from the literature on the subject, which is necessarily incomplete, in Secunderabad, sporadic cases of non-imported bilharziosis are extremely rare in this country. One author states that the disease is met with in India [8], but all other authorities to whose writings I have referred appear to deny its incidence in non-imported cases.

A further investigation into the fauna of the two suspected tanks, at present our missing link in the chain of evidence, is shortly to be undertaken by Captain T. O. Thompson, R.A.M.C. and myself and will, I hope, be of sufficient interest to justify a further note.

My thanks are due to Colonel Jack Powell, D S.O., R.A.M.C., for his permission and encouragement to publish notes on this case which is under treatment in the hospital under his command and also to Captain T. O. Thompson, R.A.M.C., Medical Officer in charge brigade laboratory, Secunderabad, and to his assistant, Mr Fruvall, I.M.D., who first identified the organisms in the patient's urine.

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NOTES ON SEVERAL CASES OF BERIBERI OCCURRING AMONGST
BRITISH TROOPS DURING AND AFTER A VOYAGE FROM
INDIA TO FRANCE.

BY MAJOR J. E. M. BOYD, M.C.

Royal Army Medical Corps.

ALTHOUGH these cases occurred some time ago, it is thought that perhaps they may prove of interest to readers of the Journal, and perhaps other officers of the Corps may be able to describe similar cases from other ships.

On August 27, 1914, two battalions of British Infantry, the 1st Manchester Regiment from Jullundur and the 1st Connaught Rangers from Ferozepore, embarked at Karachi, on the S.S. "Edavana," owned by the British India Line, for a voyage of indefinite length and for an unknown destination.

The ship was licensed to carry 1,272 natives for short voyages, from port to port, but it was arranged that over 2,000 men should be packed into her, in hot weather, for what might prove to be a long voyage.

The actual strength on board being: officers, 31; other ranks, 1,765; S. and T. natives, 76; crew, 147; a total of 2,019 in all.

As there were only the two regimental medical officers, Captain C. D. K. Seaver and myself, on board, it fell to my lot to hold the position of senior medical officer to the ship.

It may be well here to give a description of the conditions existing on the ship, shortly after the embarkation of the troops.

The after-deck was filled with stalls for officers' chargers, and machine-gun mules; in addition, there were thirty head of cattle and 400 sheep, with a few pens of fowls and ducks for use in the saloon. On referring to my diary, I find the following remarks concerning the live stock.

"Several of the cattle are very old, debilitated and quite unsuitable for food, as they consist chiefly of skin and bone. The sheep are in a slightly better condition. These cattle take up a considerable amount of deck space, which might be better used for the accommodation of the troops. These cattle together with the horses, mules and fowls fill up the whole of the after-deck from the end of the saloon deck to the stern."

When the men turned in there was a great deal of confusion, owing to lack of space, men were lying everywhere, and next morning, I personally saw one man lying in a sheep pen, clad only in khaki "shorts," a sheep was asleep with its head on his chest and another man was sleeping with his head on the sheep's back.

The usual stores, as carried by transports were taken on board, packed in cases and sacks and consisted of thirty days' sea rations plus fifty per cent; thirty days' land rations plus fifty per cent. Bread was baked daily by the men of the S. and T. Corps, and after the latter had recovered from sea sickness, was ample and well cooked. Many sacks of onions were carried, but these later became bad, and on September 9, whilst in the Red Sea, 7,000 lb. of these were condemned and thrown overboard as unfit for human food.

Water was carried in tanks and could also be distilled from the engines, about 2,000 gallons a day being available from this source.

The general cleanliness of the ship, when the troops embarked, was good.

Washing places were ample and baths were arranged for the men by fixing up the usual "sail baths."

In the after-part latrines were sufficient, but in the fore-part there were only seven latrine seats for the battalion, urinals were non-existent but were put up as soon as possible, together with more latrines in the fore-part of the ship.

After consulting Captain Seaver, I reported to the officer commanding the troops, that in our opinion the ship was overcrowded and that this overcrowding was likely to cause sickness amongst the men; both he and the Captain of the ship agreed with us, and a message was sent ashore that "owing to the overcrowding of the ships, the senior medical officer declined to be held responsible for the health of the troops on board."

The Captain of the ship did everything he could to make the troops comfortable, even allowing them to sleep on the boat deck, but later this deck had to be used for infectious cases, such as ring-worm, scabies and venereal.

On the morning of August 28, a "Board of Survey" was held by the Embarkation Authorities, and it was finally decided to remove 120 of the sheep and a machine-gun section of sixteen men, who were sent on board the S.S. "Sangola." This did little to relieve the existing overcrowding, and as the officer commanding the unit, to which these men belonged, naturally objected to having this important section away from the remainder of his battalion, they were brought back.

Later in the day the ship was moved from the quay-side into the harbour.

On August 29, at about 3 p.m., the convoy, of which the "Edavana" was a unit, sailed, but just before this the 120 sheep, taken off on the 28th, were re-embarked.

After a few days Aden was reached and later Suez; here all troops disembarked and entrained for Cairo; so far the health of the troops had been good, few men reporting sick, such cases as did occur being chiefly malaria.

Four days were spent at Cairo, and on September 18 the two battalions re-entrained, embarking the same day on the "Edavana" at Alexandria.

On September 16, two men of the Connaught Rangers were sent to hospital for "neuritis." No more cases occurred until the 20th, when there were three more, followed by two more cases on the 21st.

These five cases were sent to hospital on arrival at Marseilles on the 26th.

A fresh case occurred on the 27th, 2 on the 28th, 3 on the 29th and 2 on the 30th.

In October, 2 cases occurred on the 4th, 2 on the 5th, 1 on the 7th and 1 on the 8th, the latter being one of the two sent to hospital on the 5th who had been returned to duty. After the 8th there were no fresh cases, twenty-three having occurred altogether.

The chief symptoms complained of were weakness of the legs, with swelling and ordinary tenderness on pressure and pain in the leg and thigh muscles; in some cases there were also swelling of the face, loss of sensation in the affected parts and loss of knee jerks.

On examination only one man had anything abnormal as regards his heart, though all had some degree of dyspnoea on exertion.

The urine in every case was normal. None of the cases in the Connaught Rangers showed very severe symptoms, and no cases occurred in the Manchester Regiment, until after landing at Marseilles.

It occurred to me after four or five similar cases had appeared that these were possibly beriberi, but as I had had no experience of this disease whilst in India, I asked the opinions of others who had seen cases. The ship's doctor said that in his opinion the cases were not beriberi, this opinion was also expressed by the Chaplain of the Connaught Rangers (the Revd. Father F. Peal, S.J.), and by the Assistant Surgeon of the battalion (Mr. Pell, I.S.M.D.); as all three had had experience of beriberi and said that these cases in their opinion were not this disease, the men were sent to hospital simply diagnosed as "neuritis," and it was not until some months later that I received a letter from Captain Walker, Master of the "Edavana," in which he stated that he had been asked why he had landed cases of beriberi at Marseilles, without notifying the Port Authorities of the matter.

I recently met Captain Seaver, at the Royal Army Medical College, and asked him if he could give me any notes concerning the cases which occurred in the Manchesters and he very kindly gave me the following:—

"Condition first noticed in the Manchesters on marching into camp after disembarkation, several men falling out in the first half mile. These men complained of great pain and weakness in the legs and inability to march. From this date, September 26 until October 17, men continued to report sick, suffering from one or more of the undermentioned symptoms: weakness in the legs; pain in the thigh and leg muscles on exertion; also tenderness on pressure; oedema of the ankles; absence of knee-jerks; dyspnoea on exertion, this was marked in some cases, as was cardiac dilatation with a mitral systolic murmur. Some cases appeared anæmic; there was no pyrexia."

In all twelve men were sent to hospital with neuritis. Some of these men had rejoined the regiment by December 9, but I distinctly remember that nearly all these men were totally unfit for work, and had to be sent back to hospital almost at once."

I have no particulars as to the Companies in the Manchesters, in which these cases occurred, but in the Connaught Rangers, A Company had 8; B Company 3; C Company 4; D Company 8.

As regards the order in which these cases occurred, C Company had the first case on September 16, the sequence of cases being as follows: A Company, 4, 6, 8, 10, 13, 14, 18, 22; B Company, 15, 19, 21; C Company, 1, 5, 7, 17; D Company, 2, 3, 9, 11, 12, 16, 20, 23.

Regarding the later history of these cases in the battalion, on referring to my records, I find that 1 case admitted on October 5, 1914, was readmitted to hospital for neuritis on October 8, 1914; 1 for oedema on May 25, 1915; 1 for varicose veins on June 10, 1915; 1 for pneumonia on February 5, 1915; 1 for myalgia on November 5, 1914; 1 for fever N.Y.D. on February 27, 1915; 1 for venereal sore on September 27, 1914, readmitted for syphilis on January 14, 1915; 1 was killed in action on May 23, 1915; 1 was wounded on November 23, 1914, and 3 on April 26, 1915; 1 being missing on April 26, 1915. None of the others had returned to the battalion up to March 11, 1916, when I was wounded and sent home to England; nor am I able to say how long the men who were killed or wounded had been with the battalion after rejoining. In any case 50 per cent did not return, but may, of course, have gone to other units.

The cases were of interest, as both the battalions had been doing duty in the

Punjaub prior to the war ; there was no record of any case prior to embarkation, nor were there any cases amongst the crew or S. and T. Corps natives on the "Edavana."

The voyage from Karachi to Marseilles took just one month, with a four days' break at Cairo. The men were exercised as far as possible during the voyage, and had the usual rations. Conditions which might have led to the onset of the disease were overcrowding, with a hot steamy atmosphere due to "swabbing" between decks, especially in the Red Sea, and presumably some error of diet.

It would prove of interest if other officers, having had similar experiences, would send in their notes.

A CASE OF PARATYPHOID A FEVER.

By MAJOR G. H. DIVE, D.S.O.

Royal Army Medical Corps.

And a NOTE by Lieutenant-Colonel J. C. KENNEDY.

Royal Army Medical Corps.

THE following case is briefly described both in illustration of certain diagnostic points, and also in view of its possible bearing on certain cases of fever of uncertain origin.

The patient, a healthy adult, aged 32 years, who had been inoculated with the mixed T.A.B. vaccine in 1916, 1917 and 1918, left Mesopotamia early in June, 1921, and touched at Aden and Suez *en route* for the United Kingdom ; by the end of the month he developed fever with general pains and malaise. Under quinine this was partially controlled. He was admitted to the Queen Alexandra Military Hospital on July 8, with fever, ranging from 101° to 103°F. every evening, and falling to normal almost every night. No abnormal physical signs were detected, and blood examinations both as regards culture, malaria and agglutination for the typhoid group and the *Micrococcus melitensis* were negative except as stated below.

No organisms were found in the urine, no cysts in the fæces, and all attempts to isolate any of the typhoid group failed.

As regards the general state, extreme weakness was the most marked feature ; there was neither diarrhœa nor constipation, and the stools were normal.

On July 11 some doubtful rose spots were noted. The fever continued until August 15, a total period of some seven weeks.

In the absence of clinical data the diagnosis turned on the laboratory findings, in this case a series of agglutinations by Dreyer's method ; the results are tabulated below, end points only being given.

		<i>B. typhosus</i>		<i>B. paratyphosus A</i>		<i>B. paratyphosus B</i>
9.7.21	..	1 in 125	..	1 in 25	..	1 in 450
18.7.21	..	1 „ 900	..	1 „ 450	..	1 „ 900
26.7.21	..	1 „ 250	..	2 „ 2,500	..	1 „ 250
9.8.21	..	1 „ 250	..	1 „ 2,500	..	1 „ 250
16.8.21	..	1 „ 125	..	1 „ 750	..	1 „ 250
23.8.21	..	1 „ 250	..	1 „ 1,250	..	1 „ 250
30.8.21	..	1 „ 250	..	1 „ 2,500	..	1 „ 250

If this is reduced to graphic form the variation in the end point of paratyphoid A is very striking.

The drop recorded on August 16 was subsequent to the subcutaneous injection of pure paratyphoid A vaccine, fifty millions, on the 13th inst. The temperature fell to normal on the next day, remaining so from that time on. This was probably a coincidence, as defervescence had undoubtedly set in, but I am assured by those with experience of this line of treatment that the injection of mixed T.A.B. vaccine is very effective in controlling such fevers as the one described.

There were no complications, and convalescence proceeded very rapidly.

I am indebted to Lieutenant-Colonel D. Lawson, O.C., Q.A.M.H., for permission to publish this case.

NOTE BY LIEUTENANT-COLONEL J. C. KENNEDY.

The case reported by Major Dive, which I saw in consultation, is an interesting example of the value of the agglutination method of diagnosis in a person previously inoculated with T.A.B. vaccine.

In an inoculated person subsequently infected with one of the group, the diagnosis is rendered more difficult by (1) the, in very many cases, modified clinical course of the disease; and (2) alteration in the agglutinin content of the blood not only for the infecting organism but also for other members of the group, necessitating a series of end point observations [1, 2, 3].

In this case, clinical symptoms, apart from the fever and a somewhat slow pulse in relation to the temperature, were wanting; culture of the blood, urine and faeces likewise failed to assist in the diagnosis; and it was only when a second observation was made on the agglutinin content of the blood that it could be stated with any degree of certainty that the infection was due to one of the enteric group.

By referring to Major Dive's table it will be seen that the second observation (July 18, twentieth day of illness) showed a marked rise in agglutinins for each member of the group, and the tendency was to consider the rise for "T" as the most significant and accept this as evidence of infection with *B. typhosus*.

Now it has been my experience, and I believe the experience of most observers, that the "A" agglutinins are the least responsive to an infection by another member of the group, and furthermore that specific agglutinins for "A" tend to appear later than those for "T" or "B."

Hence it seemed to me that the rise in "A" agglutinins between July 9 and 18, though the titre reached was only half that of "T" or "B," was the most significant of the three. This reading of the case was confirmed by the subsequent observations.

The "A" agglutinins rapidly rose to a high titre, whereas "T" and "B," after their early response and a rise to a moderately high titre, soon subsided to a constant level somewhere about their original titre.

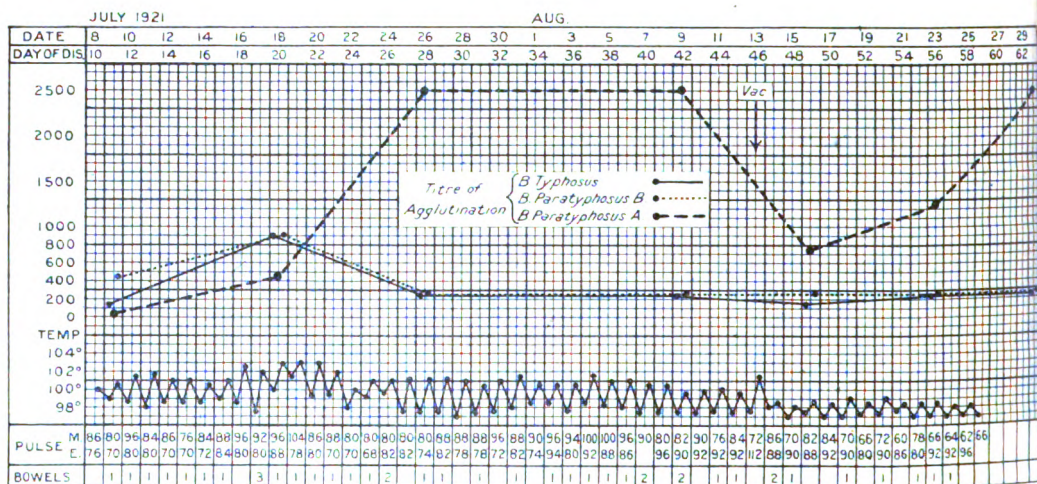
These points are brought out in the accompanying graph which affords an interesting comparison between the agglutinin curve produced by a specific ("A") and that produced by a group stimulation ("T" and "B").

Another interesting point brought out by the graph is the marked fall in "A" agglutinins subsequent to a dose of fifty millions paratyphoid "A" vaccine, and which is slightly reflected in the "T" curve.

The extent and duration of this "negative phase" in view of the dose given,

is rather surprising and is well worth the consideration of those who advocate large therapeutic doses of vaccine (200 to 350 million).

It is now some considerable time [4] since I registered a plea for the use of repeated small doses in preference to large doses in the vaccine treatment of typhoid fever—by small doses, I mean ten to fifty million—and such subsequent experience as has come, my way has only strengthened the opinion I expressed at that time.



The graph now shown emphasizes my argument. I believe that we have in vaccine a most valuable therapeutic agent in enteric group infections, but it must be administered in therapeutic, that is to say, non-toxic, doses.

It is to be regretted that in the hands of some observers vaccine treatment has not met with the success that was expected, and in my opinion this is due to the use of too large a dose, a dose which has the effect of increasing the toxæmia and depressing the immunizing mechanism.

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Lecture.

GAS WARFARE.

BY MAJOR W. R. GALWEY, O.B.E., M.C., R.A.M.C.

LECTURE IV.—ORGANIZATION IN PEACE AND WAR

WHEN chemical warfare was introduced, the task of providing offensive materials with which to retaliate on the Germans was first undertaken by the F.W. branch of the War Office. At the same time the provision of appliances for defence and protection of troops fell to the Army Medical Department, and a new section, the Anti-Gas Department, was created for this purpose.

These two branches had each the advantage of the advice of a committee of eminent scientists; in the case of offence the Chemical Committee of the Royal Society, and for defence the Anti-Gas Committee, also composed of eminent scientists.

In May, 1915, the Ministry of Munitions was formed and took over the problems of research and supply connected with chemical warfare, but it was not until October, 1917 that the Anti-Gas Department was transferred from the War Office to the Ministry and became a section of the Chemical Warfare Department. At the same time a new advisory committee of scientists—the Chemical Warfare Committee—was appointed. It consisted fundamentally of the same persons who had been on the former committee.

In 1916 the Experimental Station at Porton was inaugurated and was used from that time to the end of the war for field experiments on a large scale and for applied research into offensive and defensive measures.

The physiological staff attached to this station carried out practically all the research connected with the physiological effects and pathology of gas poisoning and also with methods of treatment. Their results, with those of other workers, were published in a series of monographs by the Chemical Warfare Medical Committee, which worked under the auspices of the Medical Research Committee.

It had become very apparent by the time that the Anti-Gas Department was transferred to the Chemical Warfare Department that any divorce of defensive from offensive research was fatal to rapid action and efficiency. The wisdom of the transfer has since been abundantly proved.

At the time of the Armistice the Chemical Warfare Department consisted of the following sections:—

- (1) Administrative headquarters in London, with the Chemical Warfare and Chemical Designs Committees attached to it.
- (2) An Anti-Gas Section at University College, responsible for research on defensive measures and the manufacture and supply of anti-gas equipment.
- (3) The Porton Experimental Station for field work and applied research on a large scale.
- (4) A small-scale Experimental Station at Wembley.
- (5) Research establishments at universities and other places throughout the country.

After the Armistice the organization went through various vicissitudes, and was finally reconstituted in its present form.

The Chemical Warfare Department is now placed under the Master-General of Ordnance, and forms a branch of the Directorate of Artillery. The organization is a joint establishment serving the needs of the three Services—Navy, Army, and Air Force.

On technical questions it is advised by the Chemical Warfare Committee.

It must be remembered that the problem of gas defence is not one of the duties of medical administration. It was so in the early days, but later was handed over to the Director of Gas Services. This step was wise; for in chemical warfare offence and defence are so closely connected that unified control is essential.

Still, many of the problems of defence and training are in the fields of hygiene and physiology, and so the medical services must be closely interested in appliances issued and decisions arrived at.

What follows is merely my personal view of what the minimum medical organization should be in peace time if we are to prepare for a future war.

The Directorate of Pathology in the War Office deals with the more purely medical problems of gas warfare, and its representatives in commands and districts at home and abroad, the Assistant Directors of Pathology and Deputy Assistant Directors of Pathology, should be kept in touch with all new work on physiology, pathology, and treatment, which will aid in the treatment and care of gas casualties. Similarly the Directorate of Hygiene should keep its representatives—the Assistant Directors of Hygiene and Deputy Assistant Directors of Hygiene—informed of work on problems of respiration and physical efficiency which bear upon the wearing of defensive appliances.

It is also essential that these officers, the Assistant Directors and Deputy Assistant Directors of Pathology and Hygiene in commands, should pass on information to all medical officers and all Royal Army Medical Corps personnel in commands.

I should also like to see every medical officer go through a course of instruction at the Army Anti-Gas School or at Porton.

Remember the essence of success in chemical warfare is surprise, and unless we are really prepared, a catastrophe may happen at the outset of the next war.

This medical organization is quite distinct from any more purely gas defence organization which may, or rather should, be devised without delay for purposes of training and inspection of equipment.

To turn now to the duties of the medical officer in charge of troops. He should in the first place be himself thoroughly familiar with the pathology and treatment of gas casualties and the methods of protection of troops.

He should when training regimental personnel in first aid give special attention to the care and transport of gas casualties and the precautions to be adopted for prevention of contamination of stretcher bearers by mustard gas.

At present this seems a counsel of perfection, as there is no manual of instruction, but if I may say so, a great step forward has been taken by the authorities in our college in making systematic lectures on the medical aspects of chemical warfare a part of the routine instruction to officers of the Corps.

There is one other most important routine duty of medical officers in connexion with chemical warfare, and that is the disinfection of respirators.

Each soldier is issued with a respirator for training purposes. He retains the face mask and mouthpiece as personal equipment so long as he serves, and the canister may be changed from time to time.

Recent experiments both in this college and in the naval laboratories at Greenwich have shown that the danger of infection of this equipment with tubercle or other germs of infection is a very real one, and that the problem of disinfection is by no means simple.

The naval authorities have had good results with 1 in 100 Izal solution. Further work is in progress in this college, but at present the instructions as to disinfection are contained in A.C.I. 373 of June, 1920, which are as follows:—

A.C.I. 373, JUNE, 1920.

Anti-Gas Service : Respirators.

(1) With reference to A.C.I. 661 of 1919, the following will be issued for the purpose of disinfection, with each training respirator in possession of troops:—

Brushes, test tube	..	..	..	1
Rags, disinfecting	..	..	..	2
Cresol (held by units and issued as required).				

Indents for the brushes and rags should be submitted to the Royal Army Ordnance Corps through the usual channels, and demands for the disinfecting fluid should be referred to officer in charge of barracks. One fluid ounce of cresol (designation liquor cresoli saponatus fortis) in 2½ per cent solution¹ should be sufficient to clean 100 respirators at one time.

¹ Standard cresol solution (2½ per cent):—
Liquor cresoli saponatus fortis 1 oz.
(Dissolved in 5½ pints of water)

(2) All respirators will be disinfected after each occasion of use for training purposes and the following procedure will be followed:—

- (a) Small box respirator in "alert" position, mask in hand.
- (b) Saturate one of the pieces of rag with disinfectant and sponge the whole of the inside of the mask, including nose-clips.
- (c) Insert into the opening of mouth-piece (it is not necessary to remove metal ring), a test-tube brush loaded with disinfectant (test-tube brush must not be freed from excess of disinfectant before insertion). Push right home to elbow with rotary movement, brush back and forwards repeatedly, fifteen seconds active brushing suffices.
- (d) Dip mouth-piece up to mask in the disinfectant. Do not shake off the excess after removal.
- (e) Hold the expiratory valve between the forefinger and thumb, across the breadth, and press lightly so as to open valve, dip as deeply as possible into disinfectant. Do not shake off excess.
- (f) Dry inside of mask with dry rag (not handkerchief).
- (g) Return small box respirator to haversack.

54 Gen. No./4305 (S.D. 4.)

It is obviously the duty of medical officers to pay particular attention to this disinfection of respirators, and to supervise it personally. It should be done not

only as a routine measure, but also when men go to hospital with respiratory diseases, sore throat, etc.

In addition to the training of stretcher bearers in first aid to gas casualties, it is highly important that nursing section personnel should be instructed in the treatment of these cases; as, for instance, in the technique of administration of oxygen with the Haldane apparatus, and of arranging a ward for giving this treatment to a large number of patients simultaneously.

Moreover, when gas casualties come, "they come not single spies, but in battalions," so that in any camp of exercise and on manœuvres medical personnel should be trained in the sorting and distribution of cases, and in arranging for the disinfection and changing of clothing infected with mustard gas.

These are all points which should be thought out and arranged for as soon as possible.

So far I have dealt with the minimum medical organization in peace time if we are not to lose ground and forget the facts already learnt, but one hopes that we shall not stop here, and that as the country recovers from the present financial stress, efforts will be made to carry out further research on the problems of treatment of gas poisoning.

Of these there are many which have only been partially solved, and some which have scarcely been tackled, and as I hope you have seen from my previous lectures, they bear upon other pathological conditions such as the pneumonias and the irritable heart of soldiers.

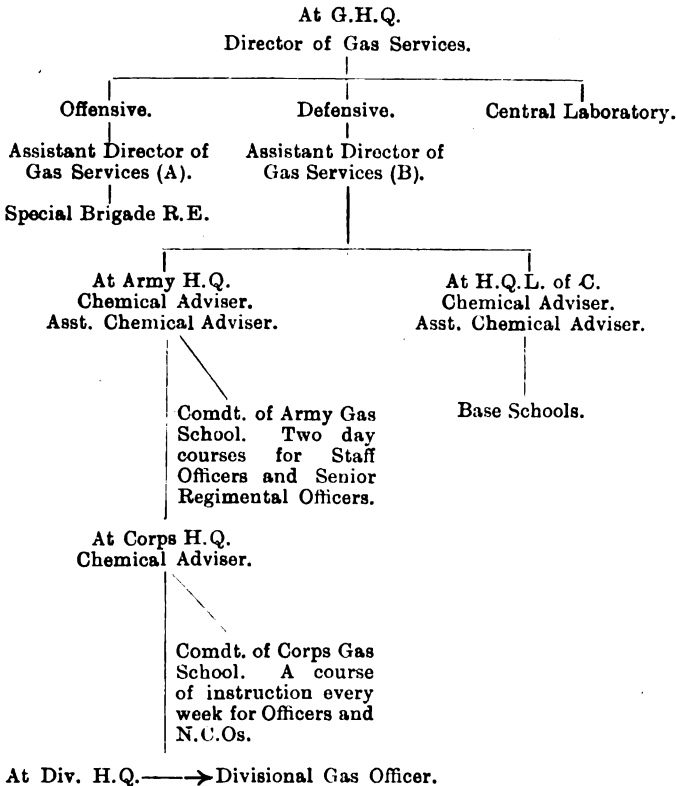
To study these we want the closest work between physiologists and pharmacologists in our universities—special men to tackle special problems, their work to be co-ordinated with other branches of chemical warfare by a special officer attached to the Medical Directorate, working in close conjunction with the Experimental Station, Porton.

But in the absence of such a scheme it seems that a little may be done by tackling the problem from the other side, and by army medical officers, whether pathologists or clinicians, studying acute lung infections in the light of the knowledge already gained by research into the physiology and pathology of asphyxiating gas poisoning. This method would give us a certain number of officers who on the outbreak of war would be more or less conversant with the subject, and partially trained to take up positions as advisers in the treatment of gas casualties with forces in the field.

For in war there can be no doubt that we shall require specially trained medical officers to advise on the evacuation, care and treatment of gas casualties, to arrange for special medical supplies, such as oxygen, and to act in closest liaison with the Chemical Warfare Services. One of the most important duties of these officers would be the circulation of medical intelligence regarding the effects of new compounds used by the enemy and the treatment of them. The anti-gas medical officer at General Headquarters would also have to be in constant communication with workers at home, both physiologists, pharmacologists and clinicians, either directly or through the Medical Directorate at the War Office.

The diagram which is before you shows the anti-gas organization which was evolved in France.

ANTI-GAS ORGANIZATION IN WAR.



The medical organization was not as complete. It consisted, broadly, of one or more casualty clearing stations for each army area, a gas centre in each division, and of certain base hospitals being set apart for the reception and treatment of gas casualties.

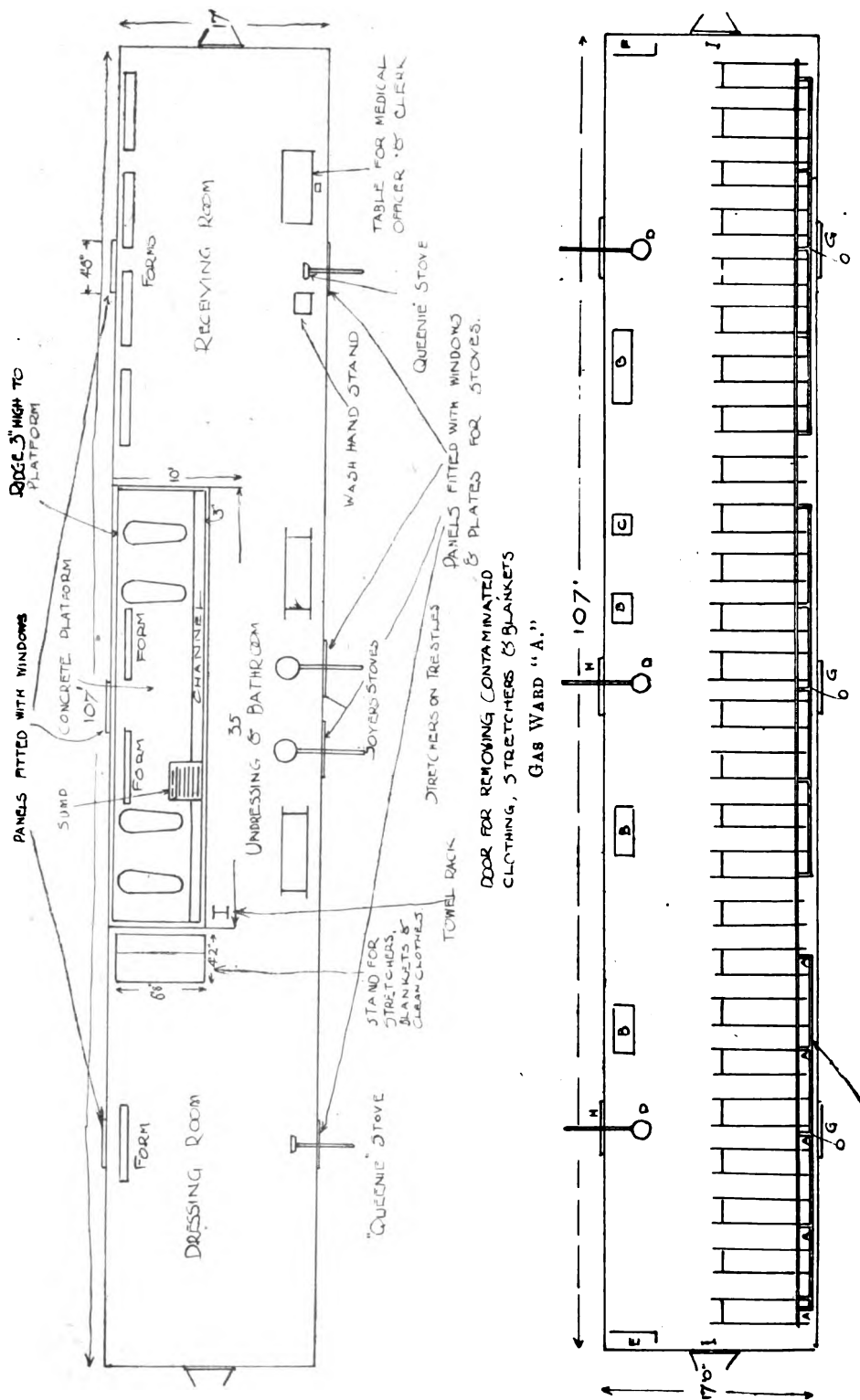
Treatment was supervised by a consultant physician, specially conversant with these cases, at the base, and one or more consultant physicians in forward areas.

There was also liaison between the medical and gas directorates at General Headquarters, and the central laboratory for defensive research had a physiologist on its staff.

This organization no doubt proved sufficient, but in planning for future wars we must remember that chemical warfare is only in its infancy, and that its potentialities are enormous, so that our organization should be framed with a view to rapid increase of equipment and personnel to meet any eventuality.

In addition to the specially trained medical officer at General Headquarters there should be similarly trained officers at each Army Headquarters and at Base Headquarters. Possibly it might be necessary to have a similar officer at each Corps Headquarters.

"GAS RECEIVING" BATHING AND CHANGING ROOMS, 141ST FIELD AMBULANCE.

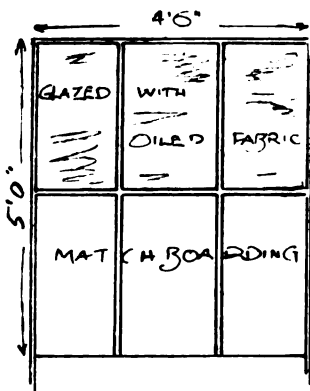
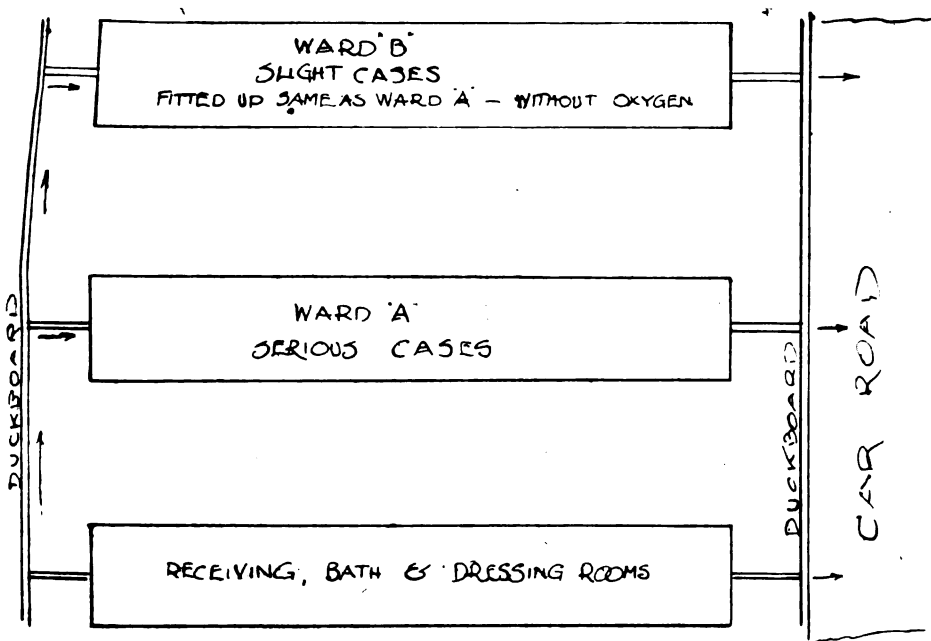


Gas piping connected to cylinder with outlet "A" for rubber-tubing to stretcher.

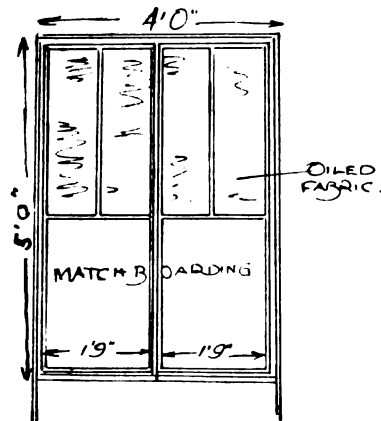
- (O) Oxygen cylinders.
- (S) Screening annexes for bedpans, urinals, etc.
- (T) Tables for instruments, medicines, feelers, etc.
- (W) Windows with plates for stove blow.
- (H) Half glazed double doors.

March, 1918.

ARRANGEMENT OF GAS DEPARTMENT.



Window panel for hospital marquee.
Iron plate, 1 ft. 6 in. x 1 ft. 6 in.,
to be fitted in required position
when stove is used.



Double doors for hospital
marquee.

As was done in France, special casualty clearing stations and general or stationary hospitals should be earmarked for the reception of gas cases, and the officers working with them should be kept informed of all developments, whether of effects of new substances used or of the treatment of them.

As regards equipment both casualty clearing stations and base hospitals should have special arrangements for disinfection of clothing and for the administration of oxygen.

Oxygen treatment should be commenced as early as possible in serious cases of asphyxiant gas poisoning showing cyanosis, but whether it can be arranged in field ambulances depends very much on the nature of the fighting, i.e., whether the units are more or less immobile, as in trench warfare, or mobile. In the latter case all one can hope for is to add a certain number of cylinders of oxygen to the equipment for use with those cases which are too ill to be evacuated. This was done in the British Salonika Force where gas was used by the enemy, though not to any great extent.

The preceding diagram shows you the arrangement of a gas centre in a field ambulance in France.

There is one other matter which will in the future need to be thought out. In the last war we had to arrange for the gas-proofing of aid posts and dressing stations. In the next we shall probably have to deal with the gas-proofing of motor ambulance wagons. Seriously wounded men cannot wear their respirators and as chemical warfare progresses it will be possible to contaminate areas far behind the front line, either by projectiles from long range guns or by bombs dropped from aeroplanes. Anyhow we must devise some means to protect the wounded man.

This new form of warfare is bristling with problems to be tackled by the medical services whether on the side of protection or treatment.

It is the duty of each and all of us to study these problems and not to leave them to specialists alone, and if we have any suggestions to put them forward.

At the beginning of the last century the great Bryant is said to have remarked that no surgeon was fit to hold the King's Commission who could not amputate an arm single-handed. In the last war the same might have been said of medical officers unskilled in preventive medicine, and in the next it may be said of him who is unfamiliar with the methods of defence against chemical weapons and the treatment of their effects.

Current Literature.

Pathology and Bacteriology: Studies on the Nature of the Action of Non-specific Protein in Disease Processes. II. Horse Serum and Soluble Toxin. D. M. Cowie and R. M. Greenthal. *Journ. Med. Research*, 1921, 40, 261.—The authors found that one cubic centimetre of normal horse serum when injected subcutaneously or intravenously into guinea-pigs simultaneously with diphtheria toxin will always protect against one and may protect against as many as eight lethal doses of toxin. Larger doses of serum will protect against larger doses of toxin, but the effect is not necessarily proportional. By precipitating normal horse serum with alcohol it was found that the protective property resides in the protein portion and not in the alcohol-soluble extract. By similar treatment of diphtheria antitoxin the authors considered that the antitoxin factor is destroyed by the alcohol. As some of the so-called "normal horse serum" on the market is taken from horses which have been previously injected with toxins or other antigens, it may be stated that the normal horse serum used by the authors was obtained from a horse in which this history could be definitely excluded.

W. B.

Comportamento della siero agglutinazione specifica verso il tifo e delle relative siero-agglutinzioni di gruppo in rapporto ad influenze diverse di natura fisica e chimica. (Influence of Various Substances on Agglutination Test.) M. Guliño. *Ann. d'ig.*, 1921, 31, 160.—The specific and group agglutinating power of anti-typhoid sera is greatly influenced and may even disappear in consequence of various treatments such as addition to the serum of concentrated solution of NaCl (1.5—2 per cent); warming of the serum at temperatures varying between 56° C. and 75° C. for one or two hours; contact of the serum with bacterial suspensions or with kaolin powder; addition to the serum of alkalis and acids.

C. d. F.

Procédé de diagnostic individuel du sang et du sperme. (Method for determining the individual sources of Blood and Semen.) M. Dervieux. *Compt. rend. Acad. d. Sc.*, 1921, 172, 1384.—Dervieux finds that the blood-serum of a rabbit immunized against human semen gives rise to precipitins when brought into contact with both human blood and semen, whilst if the animal is immunized against human blood the precipitin reaction will be obtained with human blood only.

After studying these reactions under various conditions, Dervieux comes to the conclusion that by using the serum of a rabbit immunized against human semen it is possible:—

- (1) To determine the human origin of a specimen of semen.
- (2) To state that a sample of semen comes from one particular individual, and not from another.
- (3) To determine the human origin of a sample of blood.
- (4) To determine the sex of the individual who supplied a specimen of blood.
- (5) To state that a sample of blood comes from some particular individual.

J. R. P.

Sull'infezione sperimentale da paratifo B nel coniglio. (On Experimental Infection of Rabbit with *B. paratyphosus* B.) [B.] E. Veratti and D. Cattaneo. *Boll. d. Soc. Med.-chir. di Pavia*, 1920, 33, 255.—Besredka (*Ann. de l'Inst. Pasteur*,

1919, 33, 557 and 882; *Bull. de l'Inst. Pasteur*, 1920, 18, 121), has recently shown that the administration *per os* of a certain quantity of ox bile to rabbits renders them very sensitive to infection with *B. typhosus* or *paratyphosus*. Besredka explained this fact by assuming that the bile had a desquamative action on the mucous membrane of the small intestine, thus preparing it for a vigorous development of the germs inoculated into the animals either *per os* or intravenously. Veratti and Cattaneo have repeated Besredka's experiments by means of cultures of *B. paratyphosus* B, and found that the bile, while really having the sensitizing effect observed by Besredka, has no desquamative action of any sort. In fact no histological lesions of the mucous membrane of the small intestine could be observed, even after the introduction of large quantities of ox bile into the stomach of rabbits by means of a gastric tube. On the other hand, the sensitizing effect of bile could be obtained also by means of repeated injections of the same into the subcutaneous tissue. The influence of bile upon rabbits in regard to the infection of *B. typhosus*, and *B. paratyphosus* must, therefore, be considered as due not to a local but to a general action on the whole organism.

C. d. F.

Contributo alla diagnosi microbiologica della dissenteria amebica. (On Micro-Biological Diagnosis of Amœbic Dysentery.) R. Leone. *Riforma Med.*, 1921, 37, 129.—For the rapid recognition of the amœboid forms of *Entamoeba histolytica* the best method was found to be that proposed by Cutler and Williamson (*Journ. Path. and Bacteriol.*, 1916-17, 21, 511). This consists in the employment of a freshly prepared 1 in 10,000 solution of neutral red in 0.85 per cent NaCl. A loopful of fæces is emulsified in a drop of the staining solution on a glass slide. The preparation is covered with a coverslip and examined under an ordinary high power objective. A warm stage is an advantage but is not essential. In such a preparation the vegetative forms of *E. histolytica* take up the neutral red, and the stained amœbæ can be readily seen. The pink dye is uniformly distributed throughout the endoplasm. According to Cutler and Williamson the ectoplasm remains unstained; Leone noticed that it was often coloured a pale yellow. *E. coli*, *Cercomonas hominis* and *intestinalis* are not stained and easily recognized by their greyish colour. Cysts of *E. histolytica* appear as colourless refractile bodies. According to Cutler and Williamson, *Chilomastix mesnili* is affected by neutral red when in the active condition, the bodies of the vacuoles in the endoplasm appearing pink. Instead of neutral red, Magdala red can be employed but the results are not so constant.

To start cultures of *E. histolytica*, Leone recommends the use of the slightly alkaline peptone water of Nocht in test-tubes to each of which two cubic centimetres of a freshly prepared 1 in 2,000 solution of neutral red in 0.75 per cent of NaCl are added after sterilization. Five or six loopfuls of the suspected fæces are inoculated into the tubes and these kept in an incubator at from 30° C. up to 37° C. for about seven hours. After this time, if the amœbæ were present in the fæces they will have multiplied and become stained by the neutral red, so that their recognition does not present any difficulty. For subcultures it is advisable to have resort to the egg medium of Dean and Mouat (*JOURNAL OF THE ROYAL ARMY MEDICAL CORPS*, 1916, vol. xxvi, 189 and 349) to which a few drops of human blood are added as originally proposed by Cutler (*Journ. Path. and Bacteriol.*, 1918, 22, 22).

C. d. F.

Reperto di corpuscoli nel tifo esantematico. (Minute Bodies in Typhus.) G. Ficalì. *Ann. d'ig.*, 1920, 30, 733.—As briefly described in a preliminary note on the same subject (*Policlin.*, 1920, 27, 133), peculiar bodies were at first observed by the author in the epithelial cells lining the mucous membrane of the stomach of lice found on typhus patients, but not in lice obtained from other sources. These bodies were of two forms: very small (2 microns in diameter)

with homogeneous structure, and larger ones (4 to 6 microns in diameter) containing either 4 to 5 secondary corpuscles or a single central body or nucleus. The same bodies were afterwards found by Ficaï also within and without the nerve-cells of pieces of brain obtained from cases of typhus.

The bodies stain well with diluted Giemsa, Unna's polychrome methylene blue, Ehrlich-Pappenheim's triacid mixture, toluidine blue, and thionine, but the author particularly recommends staining paraffin sections first for two to three hours in diluted May-Grünwald mixture (1 in 5), and then for twenty-four hours in diluted Giemsa's stain (1 in 20), changing this once if too much precipitation is formed. Lice are best fixed in the usual mixture of acetic alcohol-corrosive sublimate. Pieces of the brain used by the author had been already hardened in ten per cent formalin, alcohol, and Müller's fluid. In the case of the latter he found it useful to re-transfer them into ten per cent formalin for a time sufficient to extract all the bichromate.

Ficaï's bodies have a remarkable morphological analogy with those observed by Kleine and Schiffmann, Borrel and Paschen, Negri, Sinigaglia, Casagrandi, Volpino, Prowazek, Da Fano, Levaditi, in other diseases the cause of which appears to be a filter-passing virus.

C. d. F.

Ueber die Beziehungen der Fleckfieber-agglutination zum Fleckfieber-erreger. (On the Relation of Typhus Agglutination to Typhus Virus.) E. Weil and A. Felix. *Ztschr. f. Immunitätsforsch. u. exper. Therap.*, 1921, Orig. 31, 457.—This is an extensive research dealing with the Weil-Felix reaction in relation to the virus of typhus fever. According to the authors, the sera of rabbits infected intraperitoneally or subcutaneously with the cerebral substance of typhus guinea-pigs constantly agglutinate cultures of *Proteus* X 19. The cerebral substance of normal guinea-pigs has not this effect. On emulsions of various bacteria (*Proteus vulgaris*, *B. coli*, *B. dysenteriae*, *Micrococcus melitensis*, etc.), which have been said to give the Weil-Felix reaction with the sera of typhus patients, the sera of rabbits inoculated as above has no effect. No agglutinins are developed in the rabbit if the typhus virus is heated to 58° C. for half an hour. Agglutinins for *Proteus* X 19 are developed in the rabbit after such small doses as 0.001 (gramme?) of infected guinea-pig brain. By means of the agglutinating action of rabbits' serum it can be shown that the typhus virus exists in the guinea-pig brain five days after the apyrexia following the injection has taken place. If typhus virus is kept at a low temperature for forty-eight hours the inoculation of the brain of guinea-pigs which have received such virus produces only inconstant Weil-Felix reactions in the sera of rabbits.

W. B.

Beobachtungen an Todesfällen bei frischer Syphilis. (Observations on Fatal Cases of Recent Syphilis.) W. Stoeckenius. *Beitr. z. Path. Anat. u. z. allg. Path.*, 1921, 68, 185.—The author has had the rare opportunity of thoroughly investigating four fatal cases of recently contracted syphilis. All of them (a girl, aged 20, and three young men) were affected with declared syphilis in its second stage, and suffering in addition from a salvarsan dermatitis. One of them committed suicide, while the other three apparently died of acute salvarsan intoxication. At the post-mortem examination of the girl (Case I), a chronic peribronchial lung tuberculosis with fresh disseminations in the spleen, kidneys, and heart-muscle, was at first suspected; but after a more minute investigation this supposition was dropped and the alterations ascribed to acute syphilis. In the second case the author also thought at first of a nodular caseous form of tuberculosis of the suprarenal glands; but neither tubercle bacilli nor Much's granules could be detected in such organs, and no trace of a decided tuberculous process was found in any other organ. The third case was likewise mistaken for a primary tuberculosis of the mesenteric lymph glands, with secondary nodules

in the spleen, kidney, and other lymph glands. Only in the fourth case tuberculosis was excluded from the beginning, chiefly because of the absence of a primary localization from which the apparently secondary dissemination in various organs might have taken place. In addition, the minute foci found in the spleen, lymph glands, and small and large intestine had a peculiar blunt aspect and a grey-whitish colour, unlike the shining aspect of recent miliary tubercles.

Histologically all these various lesions presented the common picture of granulomata with a varying amount of necrosis and connective tissue proliferation, so that the microscopic discrimination between tuberculosis and syphilis was likewise surrounded by many difficulties. Chief amongst them was the negative result by which the search for both tubercle bacilli and spirochaetes had been attended. The histopathological diagnosis had, therefore, to be based on the results of a purely microscopic investigation. In this connexion due weight was given: (1) to the proliferation of the connective tissue around and within the focal lesions; (2) to the existence of a varying degree of exudative and infiltrative changes in the sustaining framework of various organs; (3) to the alterations of blood-vessels. As to one the author recalls the fact that a proliferation of connective tissue is generally observed also round tuberculous lesions, when showing a tendency to recovery, and that Virchow himself has emphasized the importance of the prevailing affection of the connective tissue for the recognition of alterations, almost characteristic of the so-called tertiary syphilis. The same applies to the second point and to the fact that the parenchymatous alterations were either inconspicuous or evidently secondary to those of the sustaining framework. As to the alterations of the blood-vessels, the author points out that they were widespread and of a rather changing character. Most affected were the pre-capillaries (arteries and veins), in the external and middle coats of which chiefly infiltrative and proliferative changes could be seen. A swelling of the endothelium of the smallest blood-vessels was also noticed; but as a rule the intima was the least affected. An exception to this was found in the blood-vessels of the intestinal walls of Case IV, where severe proliferative changes had resulted in thromboses of various degrees. In spite of all this, had the author not known for certain that his cases were affected by a severe form of syphilis, it might have been much more difficult, and perhaps impossible, to exclude tuberculosis in a decided manner. And this is perhaps the most instructive of his interesting observations.

G. d. F.

[The foregoing are reprinted from *Medical Science*, vol. x, No. 2, November, 1921.]

Demonstration of the Technique of the Intravenous Injection of Antimony Tartrate in Bilharzia Disease.

By J. B. Christopherson, C.B.E., M.D., *Proceedings of the Royal Society of Medicine*, vol. xiv, No. 8, June, 1921.—Antimony tartrate includes potassium antimony tartrate (tartar emetic) and sodium antimony tartrate; both are colourless, stable salts, keep well in the tropics, and can be sterilized by boiling. The sodium salt is preferred because it is less toxic and possibly as efficient, more stable, and probably more easily assimilated by the tissues of the body than the potassium salt.

Antimony tartrate has two distinct actions in bilharzia disease; it kills the ova deposited by the worms and also kills the adult worms.

Before commencing injections the physical condition of the patient should be investigated. Serious cardiac lesions and albuminuria, the result of renal deficiency, are the chief contra-indications to the use of antimony tartrate.

The best time to give the injection is about two and a half hours after a light meal and about two hours before the next meal, when the stomach is neither distended by food nor exhausted by hunger.

The injections are given every other day and commence with $\frac{1}{2}$ grain of antimony tartrate. The dose is increased by $\frac{1}{2}$ grain each injection until the

maximum dose of $2\frac{1}{2}$ grains is reached; then $2\frac{1}{2}$ grains are given every other day until the course is completed; from 20 to 30 grains are necessary. A course takes as a rule three weeks.

Young people with healthy organs stand injections of antimony well. It is not necessary to commence with less than $\frac{1}{2}$ grain in a child of 8. The maximum single dose of antimony, however, will be proportional to age; the maximum dose for a child aged 16 and under is $1\frac{1}{2}$ grains.

As antimony tartrate is an irritant a strong solution must not be used; $\frac{1}{2}$ grain diluted with three cubic centimetres of normal saline is the strength used by the author; $2\frac{1}{2}$ grains should be given with ten cubic centimetres, and intermediate quantities in proportion.

The first effect of the injections in bilharzia is to aggravate the symptoms and increase the blood in the urine. It is interesting to note that the ova disappear from the urine during the injections. The antimony tartrate appears to act on the myradia in a peculiar way; it stops the ova in their progress to the lumen of the bladder. The ova, if they do get into the bladder, have changed and become granular—they are dead. This change takes place notably when ten grains have been given and is complete after twenty grains.

At the time of the injection the pulse indicates the immediate effect of the antimony tartrate on the heart—it is a cardiac depressant. The urine should be examined at every injection to ascertain the effect of the antimony on the ova, and also on the kidneys. The patient should be weighed once a week and should not lose weight. The temperature should remain normal.

Relapses after twenty-five grains of antimony tartrate the author thinks are uncommon. Other drugs have been suggested as substitutes, notably emetine, colloidal antimony and stybinal. The author does not think that either colloidal antimony or stybinal come up to expectations; he thinks that emetine affects the ova and does not kill the worm.

T. H. G.

The Value of Laboratory Reports on Stools in Cases of Suspected Amoebic Dysentery, and their Interpretation by the Clinician: with a Special Note on the Diagnostic Significance of Charcot-Leyden Crystals. By John Gordon Thomson, M.B., Ch.B., and Andrew Robertson, M.B., Ch.B., *Proceedings of the Royal Society of Medicine*, vol. xiv, No. 11, September, 1921.—The authors commence by pointing out the great need for co-operation between the clinician and the pathologist, more especially in the diagnosis and treatment of protozoal diseases. Three points of importance for the clinician to observe when sending stools for examination are specially worthy of note: (1) Send the whole stool when possible; (2) send the stool as soon as possible; (3) when the whole stool cannot be sent, carefully select the portions that are sent.

The paper then goes on to describe the macroscopic and microscopic appearances of the stools in amoebic and in bacillary dysentery. This is followed by a short history of references to Charcot-Leyden crystals which led up to the endeavour in the London School of Tropical Medicine to further establish the relationship between these crystals and *Entamoeba histolytica*. The crystals in the stools are of the characteristic elongated, octahedral shape, aptly termed whetstone; they vary in size from 3 microns to 60 microns in length and 0.5 microns to 8 microns in breadth; the shape is fairly constant, and they take up the eosin stain readily. The final conclusions come to by the authors with regard to the Charcot-Leyden crystals are:—

(1) Charcot-Leyden crystals are probably the result of the cytolytic action of the *E. histolytica* on the body cells.

(2) Charcot-Leyden crystals are present in a very high percentage of cases of amoebic dysentery, and are more commonly present when the disease is of long standing.

(3) The presence of Charcot-Leyden crystals in human stools is diagnostic of amoebic colitis due to *E. histolytica*.

T. H. G.

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MOBILE LABORATORIES.¹

BY MAJOR A. C. H. GRAY, O.B.E.

Royal Army Medical Corps.

It is interesting to see what had been done by countries, other than our own, before the Great War to afford mobile laboratory equipment for their field armies as a protection against epidemic disease.

In the Russo-Japanese War (1904-1905) the Japanese had no field laboratory units, as units, but in one of the divisions of the Japanese Army, at any rate, there was considerable bacteriological equipment. Major-General Sir William Macpherson, in his Medical and Sanitary Reports on the Russo-Japanese War, says: "All the field hospitals of the 4th Division are supplied, from divisional funds, with a Leitz microscope and a special bacteriological cabinet." "Early in the campaign the medical officer in charge of No. 1 Field Hospital of the 5th Division had improvised a bacteriological equipment for himself; and no doubt there were many other instances of such special equipment in the field." In an appendix to Report No. 22 are given the details of this equipment. The microscope and reagents were packed in one case, the rest of the bacteriological equipment in another; neither of them weighed more than twenty pounds. General Macpherson draws special attention to the completeness, compactness and mobility of all the equipment of the mobile field hospital units.

The Russians seem to have gone even further than the Japanese, because, as General Macpherson pointed out to me, they had mobile laboratories as independent units. In a report by Major J. M. Home, of the 2nd P.O.W. Gurkhas, on Russian Medical Administration in the Field,

¹ Reprinted from Guy's Hospital Reports, vol. lxx.

we learn that five special sanitary detachments were formed. Each detachment was to consist of four bacteriological specialists, and to be furnished with a laboratory in which the most minute bacteriological investigations could be carried out. These detachments owed their origin to the initiative of the Commander-in-Chief, their object being to prevent epidemic diseases. They were all to be stationed on the railway, south of Harbin. In the event of any doubtful case of epidemic disease occurring, the nearest sanitary detachment would proceed to the spot and carry out the necessary bacteriological investigations. No description of the actual equipment of these sanitary detachments is given, nor is it stated how the equipment was packed or carried.

In the German campaign in South West Africa (1904-1906), mobile laboratory outfits do not seem to have been used. Bacteriological and chemical laboratories were provided at each base. A mobile pack-up laboratory equipment was, however, part of the medical equipment of the German Army at this time.

The Turkish Army Medical Service was re-organized in 1910, by Dr. Vollbrecht Bey, Lieutenant-Colonel in the Prussian Army Medical Service. In his scheme the sanitary officers at Army Headquarters were to be provided with a microscope, a bacteriological case, and a box of chemical reagents, just as in the German Army.

In March, 1911, shortly after mobilization for manœuvres at San Antonio, Texas, the Chief Surgeon of the United States Army gave orders for the formation of a mobile bacteriological unit. Lieutenant G. B. Foster, Medical Corps, United States Army, was in charge, and got together the equipment.¹ Lieutenant Foster claims that his laboratory was the first of its kind to be operated by the Medical Department of any army under conditions approximating those of war, but says that the Japanese were conducting a similar laboratory at Tientsin about the same time. The entire equipment packed into five chests. The whole weighed 550 pounds, and filled one-third of a wagon. Two tables, four iron buckets, and four hospital tents completed the load. The equipment was subjected to severe tests, and was transported over fifty miles of rough road. The wagon had no springs. The only breakage incurred was one flask. The entire equipment was unpacked and assembled in a hospital tent by two persons within three hours of its arrival in camp. One thousand and forty examinations were made during the four months that this "Manœuvre Division Laboratory" was in operation. In his conclusions Lieutenant Foster lays stress on the necessity of tin containers for glass-stoppered bottles, and of special chests for the equipment which should be strong, iron bound, with hinged lids and hasps and uniform in size. He considered the field laboratory not only practicable, but in this era of scientific sanitary endeavour, a necessity.

¹ *Military Surgeon*, vol. xxxi, p. 408.

The Austrians had Mobile Field Laboratories equipped by the Austrian Red Cross Society. Sixteen of such units with a specially trained staff were available in 1913.¹ In August, 1915, twenty-one mobile laboratories were said to be in the service of the entire Austrian Army.² It seems, however, that the equipment of their earlier units was not very satisfactory owing to excessive weight. A new type was introduced in 1914, designed by Stabsarzt Professor Dr. R. Doerr and Dr. Josef Winter which was easily transported on two pack animals. There is a good account of it by Colonel J. V. Forrest, A.M.S., in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS.³ Each laboratory consisted of four chests all of the same size. The weight of each case was no more than forty-five kilos, and they were made so that chest A and B, C and D balanced each other. Their construction was very ingenious. The outfits on the two pack animals were independent of each other. Chests C and D contained all that was necessary for microscopic and sero-diagnostic investigations and for preparing saline infusions and would accompany the investigating medical officer in the first place. The other pack would only be taken if a more prolonged investigation were anticipated. The equipment included sixty-four Petri dishes, flasks, pipettes, 200 agglutination tubes, a large sterilizer, disinfecting bath, a case of instruments for operating or animal post-mortems, etc., a large stock of Doerr's dried media, diagnostic sera, special tubes of bile for blood culture, etc., and a small incubator—in fact, a remarkably complete and easily transportable laboratory equipment.

Even from the above short and incomplete account it is evident that other countries have considered some sort of easily transportable field laboratory equipment a necessity. The most recent pattern introduced by the Austrian Red Cross Society seems to me to be particularly good.

Let us now see what has been done in our own Empire.

One must go a long way back into army medical history to find the first "mobile laboratory equipment" made for the British Army. I am indebted to my friend, Lieutenant-Colonel A. Bruce, of the Army Medical Department of the War Office, for information on the matter. The "Chemical Cabinet" was made for the Army by Messrs. Savory and Moore, and was probably first taken into use about 1875. Colonel Bruce remembers it well. He tells me he passed an examination on its contents in 1879. It was intended for water analysis, and was beautifully made. Each bottle and piece of apparatus fitted exactly into its partition lined with green baize. It was made of polished teak, bound with metal, and fitted into an outer case for transport. It was very heavy, but could be

¹ *Das Rote Kreuz*, No. 8, 1913, p. 169.

² "Sanitary Service of the Austro-Hungarian Army in Campaign," by Major J. H. Ford, *Military Surgeon*, vol. xl, p. 650.

³ JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, vol. xxiii, p. 651.

lifted by two men. A new pattern of cabinet was introduced in 1897 of the same general character and dimensions as the old one, the contents, however, were altered and improved. These cabinets were used both at home and abroad. They went to Egypt with the Army in 1882, and to South Africa in 1899. They were sent out to France in 1914, but I do not think they were used in the Great War. General hospitals are mobile units in the British Army, and laboratory equipment was prepared for them when our medical equipment was overhauled after the South African War. During the South African War base hospitals were provided with microscopes and with laboratory equipment when demanded, but there was no standard equipment. Smaller and more portable "water analysis cases" were made for use in the field.

The first real mobile laboratory appeared in the Southern Sudan, but had no connexion with the Army.

In 1906, Dr. Andrew Balfour, Director of the Wellcome Research Laboratories, Khartoum, conceived the idea. At his instigation a two-decked barge was built by the Sudan Government and was fitted out by Mr. Wellcome, with every possible requirement and convenience. Early in 1907, this floating laboratory was ready for use. A full account of it is given in the "Third Report of the Wellcome Research Laboratories 1908," by Dr. C. M. Wenyon. In his report he says: "The large laboratory, with its two long benches, water taps and sinks, with water supply from a carbon filter on the upper deck, ample cupboard room for bottles and glass ware, the incubators and ovens, the balances and centrifuge and all other equipment, reminded one more of a laboratory at home than the accommodation one would expect to find on one of the upper tributaries of the Nile in some remote corner of the Sudan. The advantages of such a laboratory with everything at hand, with solid benches on which to stand one's microscope, with a good supply of clean water, will be sufficiently evident to anyone who has tried to work in a dusty tent, with apparatus stowed away in boxes, with the microscope on a rickety table, and with a limited supply of water. The floating laboratory is, as far as I know, the first of its kind. Though further experience may introduce improvements, those who originated the scheme and those who were far-sighted enough to carry it into effect, are to be congratulated as being the first to introduce this mode of scientific investigation." To compare this, the first floating mobile laboratory, with the type of motor mobile laboratory which we used in France, Salonica and Egypt is perhaps hardly fair; the latter had to be strictly limited in size and weight and had to cope with roads of the roughest description, whereas the former could be of generous dimensions and travelled over the comparatively smooth waters of the Nile; yet this, the first laboratory of its kind designed fourteen years ago is still in constant use, and has not been surpassed since or perhaps even equalled. No other laboratory has yet been designed which could and did function while actually on the move. Incubators and sterilizers can hardly be kept

going with safety in any type of motor laboratory, when travelling over even moderately good roads.

The first suggestion that I can find with regard to field bacteriological equipment for the British Army is in a paper by Lieutenant-Colonel R. H. Firth (now Colonel Sir Robert Firth), written in 1909 on "Sanitary Companies—Territorial Force."¹ In discussing the details of these Sanitary Companies, which are Army Troops, Colonel Firth says that a microscope and a limited bacteriological outfit must form part of their equipment.

The first suggestion of a fitted motor mobile laboratory for use with the British Army in the field was made by Major S. L. Cummins (now Colonel S. L. Cummins), R.A.M.C., in his Parkes Memorial Prize Essay written in 1912.² He says "The early diagnosis of typhoid fever is a matter of blood culture. This requires skill, care and deliberation, but not an elaborate outfit of bacteriological appliances. Our idea is that a mobile laboratory consisting of a closed motor vehicle, containing the apparatus for preparing media, incubating cultures, and for the necessary microscopic work and other work of isolating bacteria, should be attached to each division and accompany this formation as a part of the Divisional Headquarters. A specially trained officer with two trained orderlies (one as batman) and a driver (R.A.S.C.) should constitute the staff. Regimental medical officers and officers commanding field ambulances should be directed to co-operate with this officer by sending to him all suspicious cases for blood culture and such other work as may be necessary. At present his work is allocated to the laboratory at the advanced base or railhead (vide Royal Army Medical Corps Training, paragraph 147, iii). Our plea is for a mobile laboratory marching and working with the Divisions."

It was soon evident to our Headquarter Medical Staff in the field that a mobile laboratory was a necessity. The Great War was not much more than a month old when a telegram was sent to the War Office asking that such a unit should be sent out. The matter was referred to Sir William Leishman, Adviser in Pathology to the War Office, who asked the Director of the Lister Institute, Dr. C. J. Martin, to staff and equip a motor laboratory as quickly as possible. The work was soon done. The late Major S. R. Rowland, of the Lister Institute Staff, was appointed to take charge of the laboratory, and it was he who chose the all-important vehicle. He had seen a car of the type he wanted at the Motor Show of 1914. It was probably the only vehicle in existence which could have served his purpose, and after an exciting hunt it was found. It was a huge car of enormous weight and power. The body was a luxuriously fitted caravan, with water tank and water closet complete, the roof carried any amount of extra luggage. It originally belonged to Mr. Du Cros. The chassis was, I believe, specially built in the Austin works. The internal dimensions of

¹ JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, vol. xiii, page 548.

² JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, vol. xx, page 685, and vol. xxi, page 39.

the body of the van were as follows : Height, 6 feet 7 inches, length 12 feet 6 inches, width, 6 feet 9 inches. The car was taken to the Lister Institute Serum Department at Elstree and was there fitted out. Dr. Martin, Dr. Ledingham and Miss H. Chick all helped Major Rowland in the choice of his equipment. Work bench, autoclave, Koch's steamer, incubators and sterilizers were screwed into their places ; the experimental animals in their cages were hoisted on to the roof, and the unit set out for France on October 9, 1914.

The next motor bacteriological laboratory to go to the front was given to the War Office by an anonymous donor. The car was known as the "Princess Christian Motor Laboratory." I had the privilege of taking it to France. It consisted of a large van-shaped body, divided into two compartments, on a 20-30 h.p. Clement Talbot chassis. The internal construction, fittings and equipment were devised and carried out by Messrs. Baird and Tatlock. The work room was 6 feet 6 inches by 6 feet. The smaller compartment, 6 feet by 2 feet 10 inches, shut off by sliding doors, housed the incubators and sterilizers, etc. There was an electric fan to aid in ventilation, and a powerful lighting outfit. A good illustrated account of it appeared in the *Lancet* of January 23, 1915. The weight, with its driver, was three tons eight hundredweight. I think the chassis was carrying more than thirty hundredweight ; it was a surprise to me how well it went. There was an overhang at the back of four and a half feet. The weighty contents had to be carefully arranged to get the heavy things well forward and between the wheels. The water tank was emptied before a journey. The generous donor, at my request, added a powerful motor bicycle and box side car to the unit, which much increased its usefulness. The absolute necessity for a light "tender" for mobile laboratories was recognized later on, and all were provided with 10 h.p. Singer cars.

A similar laboratory was taken to France by Major J. W. McNee—he started a few days before I did but had only got as far as Havre when the springs of his "bus" flattened out and he had to come back. His unit was subsequently known as No. 3 Mobile Laboratory.

It was soon evident that these last two were over-weighted ; such a load spread over such a large area of floor space was too big for any car that had not been specially made, so, after these first three, all motor laboratories used by us were lorries and not cars. This was an improvement, but the fact that these laboratories were now on solid instead of heavy twin pneumatic tyres made it necessary to pack the contents more securely than before. The late Major Rowland knew a good deal about motor cars, and I remember that he considered a good chassis for a motor laboratory should be long, with as little overhang as possible ; that the driver should be seated over the engine to give extra body length, a point which has been adopted in the latest type of motor omnibus ; that the width of the body should be increased by building it to overhang the wheels. In his opinion large twin pneumatic tyres were a necessity. With regard to the fittings inside, he

considered there should be a definite place for everything, but all apparatus should be capable of easy removal so that if thought desirable it could all be quickly taken out and put into a room, and as quickly put back again; in fact, his plan was to use the van as a large packing case on wheels, but to leave as much free space in it as possible, so that it could be used as a work room when necessary. Major Rowland had got the one motor caravan which fulfilled all the conditions and it had been specially made. To have built others would have probably meant a great delay. The two-ton Daimler lorry chassis was adopted, and proved satisfactory.

By the end of January, 1915, there were then three Mobile Bacteriological and one Hygienic Laboratory in France, this last in charge of Captain M. Coplans, an old Guy's man. I think in the opinion of General Headquarters they were of real value, because in May, 1915, the scale was increased to two Mobile Bacteriological Laboratories per Army, and later on there were even more.

No. 1 Laboratory started work at St. Omer. No. 2 was ordered to Bethune, but soon back to Lillers as Bethune was rather heavily shelled on January 23. No. 3 opened out at Bailleul, and soon spread into a convenient building. No. 4, the Hygienic Laboratory, was, I think at Bailleul too.

How well I remember those early days at Lillers. It was Army Headquarters then and correspondingly important. Major D. L. Harding was in command of the Casualty Clearing Station which gave me welcome, and it was he who guided me aright along the unfamiliar paths of War. It was there I first met Captain Adrian Stokes. At the time of the Battle of the Aisne, Captain Stokes had been sent to Paris to buy what bacteriological equipment he could find, and had brought it back to the line in a motor cycle and side-car—neither of them new. Without any special name to his laboratory, and with very little equipment, Captain Stokes had been doing the work of "mobile bacteriologist" to the whole Expeditionary Force for weeks before even Major Rowland arrived on the scene, and had been doing it thoroughly well. When I arrived he gave up his room to me, and in obedience to orders joined No. 1 Mobile Laboratory at General Headquarters. It was a first floor room in a little side street just opposite the school which formed part of No. 4 Casualty Clearing Station. It made a good laboratory. My "'bus" was in the street below, supplied me with electric light, and was used by my staff-serjeant for the preparation of media, etc. At first I used the "'bus" as a laboratory. The body was "jacked up" on to wooden blocks which gave the necessary rigidity for microscopic work, but the position of the vehicle up against the side of a wall did not allow of much daylight getting in. Any other position would have blocked the street. Again, when my staff-serjeant was using the sterilizers the steam condensed on the lenses of the microscope—also he had to move about to do his work, and that meant vibration.

Major Rowland used his car as his "microscope room" for some while, all his sterilizing and media preparation were done elsewhere.

Captain R. L. Thornley, who came out later in charge of No. 20 Mobile Laboratory, always used the "bus" as his laboratory, and preferred it to a hut. No. 21 Mobile Laboratory, in charge of Captain Emrys Roberts, came out early in 1916, and was at Bethune. His laboratory was, I think, the most magnificent in France. It was given to the Army by Dr. Lynn Thomas (now Sir John Lynn Thomas), and was very much larger than any of the others. It was a caravan mounted on a large lorry.

We had plenty of work to do in France; quite half the day, and sometimes half the night was spent in the open air journeying between the Field Ambulances and Clearing Stations, collecting specimens from "suspected" cases. Messrs. Baird and Tatlock made me a most convenient case containing all the necessary implements for blood culture, etc., with special compartments for sterilized syringes, large tubes of extra thick glass containing the solution of peptone and bile salt, metal spirit lamp, sterile swabs, etc. It was always kept ready, and was in daily use. For making blood cultures in the field I found that large very thick glass test tubes plugged with a sterile rubber bung were the best; no amount of shaking could harm the contents. As soon as I got home to the laboratory the rubber bungs were changed for woollen plugs, and the tubes placed in the incubator. I always carried at least half a dozen all glass syringes of two cubic centimetres and five cubic centimetres capacity, ready fitted with their needles, each syringe in a large thick test tube well plugged with wool. These were sterilized in the autoclave just as they were, and it was very rarely that one got broken in the process. My staff-serjeant's first duty, when I came back from the daily round, was to clean the syringes, resterilize them, and fit up my travelling case with fresh tubes of media, etc. It was then ready for any urgent call. The day's work began with an examination of the previous day's cultures, the reading of the results, and the dispatching of numerous telegrams; each positive case of typhoid fever or other serious infectious disease had to be notified by telegram to the Officer Commanding the Field Ambulance or Casualty Clearing Station in which he had been seen, to the Assistant Director of Medical Services of the man's Division, to the Director of Medical Services of the Army, and finally to General Headquarters. Infectious disease notification forms (A.F. W.3110) had also to be completed in duplicate, and then all details entered in one's own laboratory note-books.

By eleven o'clock a good number of telephone messages and telegrams would have arrived demanding one's presence at various units. The bicycle and sidecar was got out, and the round started. I wonder what the columns of marching men one passed in the narrow roads thought of the little box which went bouncing past attached to the motor bicycle with its anxious-looking dusty driver. I think I was generally looked on as a new sort of postman, or else was given the credit of burying stray corpses. I found it much better to go to the case myself than to ask for "swabs" or samples to be sent. By the time the "swab" had reached the labora-

tory it was cold and uninviting, and, with the exception of those from diphtheria suspects, generally quite useless.

I arrived in France just at the beginning of the "cerebrospinal" scare, and the examination of "contacts" soon became a serious business. I did not mind how many individuals arrived to be examined, or how many I went to see; these I could deal with, but bundles of "swabs" taken the day before, or even earlier, came in by post and by motor-cyclist. They were generally relegated to the lysol bowl.

I think it was "swabs" from "doubtful ladies" taken by civil practitioners which required the greatest mental effort. I never returned them with sarcastic comments, partly because my French was not good enough, and also because I was so afraid of being asked to go and see the patient. I always hunted through the slides, perhaps with a mental bias towards the positive. In my opinion the "mobile bacteriologist" is best serving his country when journeying about seeing every case and every "contact" himself—if he once begins to sit in his laboratory and merely examine samples taken by others his work will deteriorate and his opinion lose its value.

We all of us, I think, fitted up some sort of apparatus which kept Petri dishes warm on our journeys. Swabs were then taken on the spot—the plates were spread and put back into their "hot box." It was not necessary to examine all the contacts of a case of cerebrospinal meningitis, we had permission from headquarters to make our own selection. The actual cases of disease presented far less difficulty; these we could lumbar puncture, blood culture or otherwise deal with, and one was sure of getting a clear cut result.

Mere records of the number of cases of each disease examined are of little interest. We were all very busy. I think the hunting out of a paratyphoid carrier in the 2nd Royal Sussex Regiment, when in rest at Noeux-les-Mines, gave me the hardest work. The thing had to be done quickly as the regiment was due back in the line. The regiment was well inoculated against typhoid, but luckily, from my point of view, paratyphoid inoculation had not yet been started. The outbreak was definitely paratyphoid B. I had seen all eleven cases myself, and had got positive blood cultures from many of them. In all the infecting organism presented identical characters in the various sugar media, and with the stock laboratory anti-sera gave the same results. There was not time to take a blood sample from every soldier in the regiment, so I contented myself with examining all the recent arrivals and all those who had been to hospital sick. There were about ninety of them. A sample of blood was taken from each and carefully labelled. There was not time to put up more than one dilution of each serum against the infecting organism. I chose a dilution of one in a hundred as likely to show something definite, and it did. One man's serum of the ninety examined gave a marked result. I wired to the Assistant Director of Medical Service of the Division that night to isolate

him and send him to a field ambulance. The man's stools were plated, and at the second attempt, after a generous dose of physic, the paratyphoid organism was found, identical in every respect with that found in the actual cases. Of course, there may have been another carrier amongst those I did not examine, but after the removal of this man there were no more cases in that regiment.

Our work in the field was co-ordinated by Colonel (now Major-General) Sir William Leishman, who visited us at regular intervals. To him we poured out our troubles, and he always gave us a sympathetic hearing. I am sure that my confrères will agree with me in saying that any success we achieved was chiefly due to his inspiration and advice.

Our consulting physician too, Colonel (now Major-General) Sir Wilmot Herringham, was deeply interested in us. He often came to my laboratory just as he did to the others, and his ripe experience was always at our disposal and his suggestions were invaluable.

Best of all, because we were daily at their beck and call, our Directors of Medical Service showed they relied on us by giving us plenty to do.

When big things were happening, such as the battles of Neuve Chapelle and Loos, we "downed tools" and gave a hand to the nearest Casualty Clearing Station. Everyone who could put on a dressing or give an anæsthetic was wanted then, and the "sick" were simply not to be found. Soldiers did not go sick at times like these, but preferred to stick it out however bad they felt.

What of our patients? Were we popular with them? No, that I am afraid could scarcely be expected. The man who sticks a needle into his suffering brother cannot look for popularity, but perhaps later, when convalescence gave life a rosier look, we got credit for doing our best.

My personal experiences with a mobile laboratory only lasted until July, 1916. It was then a case of the biter bit, for I contracted paratyphoid A fever and had to retire to bed. I had been well inoculated against typhoid and also against paratyphoid B, but not against the third variety. When I at last arose from a bed of sickness, I was, at my own request, given the command of another unit. No. 2 Mobile Laboratory was rather unfortunate in the way of illness. Captain A. L. Urquhart, who joined me early in 1915, first went down with measles of the most virulent description, and then, after bravely experimenting on his own body with lice from fever patients, got trench fever. Captain Urquhart has not yet had the credit he deserved for this, the first experiment. After his recovery he took a mobile laboratory to Salonica. There were others, however, who gave all they had. Major Rowland died of cerebrospinal meningitis caught from the very patients he was trying to help. Captain T. Strain, of No. 6 Hygiene Laboratory, died from an accident when working with dangerous gases at Lillers.

The travelling laboratory has, I think, come to stay. In some form or other it was used by all armies in the Great War, and it might be used to advantage by civil authorities too.

When epidemic disease breaks out and "contacts" have to be examined in large numbers, such examination can only be effectively done at a laboratory. If the expense is not prohibitive, it is surely better to take the laboratory to the "contacts" rather than to move numbers of possibly infected people about the country, and one travelling laboratory might take the place of several permanent ones.

The type of motor laboratory that we used in the Great War seems to me to have been too cumbersome and too heavily equipped. Something after the French Colonial Model which was designed by Dr. Tilmont and fitted out by Messrs. Baird and Tatlock, would, I think, be more generally useful. This type was fitted to a Ford chassis.

If all media were prepared in some central laboratory and distributed to the various field units, most of the heavy equipment in the latter could be dispensed with.

For use in countries where a Ford car could not go, the mobile laboratory would have to be packed for animal transport or even in fifty pound loads if it had to be carried by natives, but it seems to me that large armies could not operate in such countries, and there would be no need to have many of this latter type.

MALARIA IN MACEDONIA, 1915-1919.

PART V.

ENTOMOLOGICAL OBSERVATIONS ON MOSQUITOES IN
MACEDONIA.

By J. WATERSTON.

Captain Royal Army Medical Corps (Territorial Force).

THE following report has been limited by many considerations and its scope may be briefly indicated. It does not pretend to give a complete account of the entomological investigations made in 1917-18-19, nor does it deal, unless incidentally, with the anti-mosquito campaign on the Macedonian Front and its results, details of which must be looked for in the report of the Director of Medical Services.

Some special points again, e.g., the hibernation of Anopheline mosquitoes in Macedonia; the infectibility of various species of *Anopheles* and their respective rôles as malarial carriers have been dealt with elsewhere.

I have here tried only to summarize our knowledge of the Culicid fauna of Macedonia and to record besides such notes of biological interest as observations in the field or laboratory have afforded. As originally planned, this report would have embodied a considerable number of observations on the morphology of adult mosquitoes and their larvæ, which in some cases had not previously been met with. But as I understand Mr. F. W. Edwards has in contemplation a complete revision of the "Culicidæ of the Pala-arctic Fauna," I have thought it better to leave my preparations in his hands. For the same reason no synonymy has been given for the species listed, but in every case, with one exception,¹ only the oldest name known to me has been employed. Keys have been drawn up for the species under each genus.

Although it was not among our primary objects to survey the Culicid fauna of Macedonia, the large collections of larvæ accumulated during the search for breeding-places of mosquitoes and the subsequent rearing of the adults, yielded a very full list. Probably two-thirds at most of the indigenous species were secured and additions might easily have been made, had it been possible to devote more time to an examination of the marshes nearer the sea. The bulk of our material, however, came from Corps areas. In August, 1917, from Karasouli as centre, the Vardar valley, the Vardar-Doiran Front and from the north end of Lake Amatova, to some distance beyond the north end of Lake Ardzan were explored.

¹ *Stegomyia fasciata*, F., retained because of its wide currency in medical literature, see Edwards, *l.c.*, p. 129 f.n.

In September, work was carried on, in and around Lahana and along the Struma valley, and during October more attention was again given to the Karasouli station. In the spring of 1918, some days were spent at Mikra and many excursions made, through the courtesy of French colleagues, to the Vardar plain and marshes. In May-June at Stavros, investigations were made on tree-breeding mosquitoes, and along the Beshik-Langaza plain. In the early autumn, a second travelling laboratory for purely entomological work was established, visiting in turn Janes-Doiran and Vetrina. In this way the ground was thoroughly quartered except perhaps between Snevece and the west side of Lake Butkova where little collecting was possible.

In the following list of Culicidæ twenty-six species and two varieties are recorded for Macedonia. Of these all the *Anopheles*, the *Stegomyia*, *Teniorhynchus*, one of the *Finlaya*, one *Ochlerotatus* and two *Theobaldia* were more or less constantly in evidence by their attacks. None of the others—and in particular no *Culex*, though from time to time single specimens were secured blood gorged in tents, etc., was a source of much annoyance to our troops. Of course by going into special environments, e.g., mud flats or marshes near the sea one might be attacked by mixed hordes of *Ochlerotatus* (mainly), but in general only *O. caspius* was troublesome in billets, etc. Out of some thousands of *Culex* larvæ reared not one example of *C. fatigans* was determined though some hundreds of dissections in all were made of the ♂ genitalia with a view to discovering this species. All the alleged or suspected *fatigans* brought to the laboratory at 52nd General Hospital were *C. pipiens*. Whether then true "Dengue" fever occurred during the war in Macedonia or not—and the matter is one on which I am not qualified to give an opinion—the presence of its generally admitted carrier was not demonstrated.

In the notes to the species particular attention has been paid to the known range of each form. In some cases, e.g., *O. echinus* and *O. lepidonotus* our knowledge of the distribution is palpably incomplete, but in the others two types may be noted: (a) a circum Mediterranean range extending eastwards to Mesopotamia or beyond. This includes the bulk of the species dealt with though, of course, the range of particular forms may be more limited, e.g., North Africa may not be reached; (b) similar to (a) but with a great extension southwards along the East Coast of Africa, e.g., *Theobaldia longiareolata* and *C. tipuliformis*.

Compared with the European Culicid fauna generally that of Macedonia offers no striking novelty. The genus *Orthopodomyia* was not found, but should occur. In *Anopheles*, unless some of the Palestinian or Egyptian species have effected a passage, the only addition to be expected is *A. hispaniola* Theo. This species, however, is at present reported only from Spain and North-west Africa, and as its line of migration has probably been via the Straits, its occurrence so far east would be a matter of surprise. No further additions are to be expected; to the groups

Uranotania, *Tæniorhynchus*, *Finlaya*, *Culicella* and *Allothcobaldia*. One *Theobaldia* (*T. glaphyroptera*, Schin.), may yet be turned up in Macedonia, but though distinct it is at present known only from Austria, Strasburg (Eckstein). One or more *Stegomyia* and *C. impudicus*, Fic., may, however, still be reported from Macedonia (see also notes at end of table to *Ochlerotatus*).

I have to thank Mr. F. W. Edwards for much kind assistance in drawing up these notes on distribution and also in the construction of the keys. The rich collections of the British Museum have been freely consulted for data. Most of the determinations of the species listed rest on bred specimens. During the two years very large numbers of larvæ were reared, in many cases from the egg. At first careful records were kept of the times occupied by each stage, but these were found to be so variable that observations were discontinued.

One point in the oviposition of the egg-scattering species of mosquitoes (*Anopheles* and *Ochlerotatus*) may be worth recording, viz., their partiality for laying at the edge of the container where a thin film of water mounts the sides by surface tension. Scattering of grass stems over the water surface assists oviposition, or at any rate secures a more even distribution of the eggs. At first one was inclined to think that the aggregation of eggs towards the sides was due to purely mechanical causes, and in part this may be a true explanation. Females, however, of both genera named were observed to stand on the side of the jar and lay on the thin film, and this probably explains how some larvæ succeed in going through their metamorphosis in fairly quick-moving water behind posts, etc., on whose wet surface oviposition has taken place. In the same way eggs of *A. superpictus* were recovered from the sloping sides of hill streams, the dark water-stained soil being shaved off to a breadth of six inches above the moving water and levigated in a pail of water from whose surface the eggs were then recovered. If further observations should prove this habit to be at all widely spread in the genus *Anopheles*, its importance to the sanitary officer is obvious.

While the advisability of oiling surfaces uncovered by receding water in order to ensure the destruction of stranded ova, etc., has long been admitted, the importance of extending the treatment to the margins of streams, pools, etc., has possibly not been sufficiently emphasized. In the field, ova of *Anopheles* spp. were noticeable mainly on sheltered water surfaces along the sides of the pools. But—especially in the case of hill streams as already remarked—the damp sides themselves may be equally important nurseries.

As regards the food of the larvæ few observations were made. All to begin with are probably dependent on bacteria or other micro-organisms but in their last and penultimate stages *A. maculipennis* and *A. hyrcanus* feed largely on *Spirogyra*, when available, a taste shared by them with *C. mimeticus* and *C. pipiens* and possibly other Culicines as well. In their last stage, especially for a day or two before pupating, *C. pipiens*, *T.*

longiareolata, and *T. annulata* (and to a less extent the *Anopheles* spp.) appreciate a diet of chopped flies. The larvæ cluster round the fragments eating the soft parts and leaving the chitinous shell. In dugouts and situations where insects were found drowned, one met with similar clusters of larvæ which, as has been suggested to me, may have been feeding on bacteria or other saprophytic organisms, but under laboratory conditions the soft, fresh insides of insects were certainly devoured, with, one may add, a marked acceleration of the time required for pupation. The tree breeders too, I believe, fed largely on insects, for recent fragments of some species were present in the very dark brown fluid from which the type of *F. echinus* was reared.

A considerable time was devoted to a study of the natural enemies of larvæ and adults, but the results were disappointing, and their value uncertain. I have already given some notes on this point, and would only add that not till the spring of 1918 was a whole-hearted enemy of the larvæ found. In a wet meadow near the Galiko river, where during the latter part of April larvæ of some eight species of Culicidæ (including one *Anopheles*) were observed, continual and widespread destruction was effected by larvæ of water beetles (*Acilius* sp.). The *Acilius* killed many more larvæ than they required for food, but practically all the *Anopheles* escaped, when batches were kept in the laboratory, till the Culicines had fallen victims. *Anopheles* had less difficulty in swerving from the scythe-like jaws of its enemy, while the Culicines hanging more directly downwards, and with the bulky thorax lower in the water, were more readily seized. In this way the usefulness of *Acilius* is probably limited where many Culicines are present with *Anopheles* larvæ. In a bowl in the laboratory half a dozen *Acilius* killed about seventy mixed Culicines in a single night.

The flight of *Anopheles maculipennis* is, at any rate, towards the end of the season, not continuous throughout the night, and its attacks are then apparently confined to two periods—the first in the late evening and the second towards dawn. At various times I heard vague reports to this effect, and in localities where *Anopheles* were numerous, one could not fail to note the onslaught of these insects commencing at or shortly after dusk. But I had no opportunity of finding out how far into the night such attacks would continue. During the last week of September, 1918, at Janes, I was sleeping in an unheated laboratory in which during the day I had counted fourteen *A. maculipennis* at rest. My work on two nights kept me up practically till dawn, and on both occasions the *Anopheles* were active for rather over an hour after 8 p.m., and offered to attack one. But between 10 and 11 they came to rest again and remained so for some hours within arm's length of the table at which I sat. They were on the wing again about dawn. This interruption of the nocturnal flight was probably due to a fall in temperature (the difference between day and night being marked by the end of September), but possibly during the warmer months the flight is continuous.

In concluding these more general notes I should only like to add my thanks for the collecting zeal shown by so many of the officers and personnel of the British Expeditionary Force in Salonica. If this help has not always been individually acknowledged, it has been none the less appreciated. To my colleagues of the French Anti-malarial Mission my hearty thanks are due not only for their unvarying courtesy but for the disinterested sharing of any discovery or information which seemed likely to be of help in our common work.

SYSTEMATIC LIST OF MACEDONIAN MOSQUITOES.

FAMILY CULICIDÆ.

SUBFAMILY I.—CULICINÆ.

Tribe I.—ANOPHELINI.

Genus ANOPHELES, Mg.

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| 1. <i>A. maculipennis</i> , Mg. (1818). | 4. <i>A. plumbeus</i> , Steph. (1828). |
| 1a. <i>A. maculipennis</i> , Mg. var., adhuc
non descr. | 5. <i>A. superpictus</i> , Grassi (1899). |
| 2. <i>A. bifurcatus</i> , L. (1758). | 6. <i>A. hyrcanus</i> , Pall. (1771). |
| 3. <i>A. algeriensis</i> , Theo. (1903). | 6a. <i>A. hyrcanus</i> , Pall. var. pseudo-
pictus, Grassi (1899). |

Tribe II.—CULICINI.

Genus STEGOMYIA.

Stegomyia fasciata, F. (1805).

Genus OCHLEROTATUS, Arrib, Sub-Genus i, *Finlaya*, Theo.

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|---|-------------------------------------|
| 1. <i>O. geniculata</i> , Oliv. (1791). | 2. <i>O. echinus</i> , Edw. (1920). |
| Sub-Genus ii, <i>Ecculex</i> , Felt. | |
| 3. <i>O. vexans</i> , Mg. (1830). | |

Sub-Genus iii, *Ochlerotatus* sens. str.

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|---|---------------------------------------|
| 4. <i>O. caspius</i> , Pall. (1771). | 7. <i>O. detritus</i> , Hal. (1833). |
| 5. <i>O. pulchritarsis</i> , Rnd. (1872). | 8. <i>O. rusticus</i> , Rossi (1790). |
| 6. <i>O. lepidonotus</i> , Edw. (1920). | |

Genus TENIORHYNCHUS, Arrib.

1. *T. richiardii*, Fic. (1889).

Genus THEOBALDIA, N.-L.

Sub-Genus i, *Allotheobaldia*, Brole.

1. *T. longiareolata*, Mcq. (1838).

Sub-Genus ii, *Culicella*, Felt.

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| 2. <i>T. fumipennis</i> , Steph. (1825). | 3. <i>T. morsitans</i> , Theo. (1901). |
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Sub-Genus iii, *Theobaldia* (sens. str.).

4. *T. annulata*, Schrk. (1776).

Genus CULEX, L.

Sub-Genus i, *Neoculex* (sens. str.).

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|---------------------------------------|---------------------------------------|
| 1. <i>C. apicalis</i> , Adams (1903). | 2. <i>C. hortensis</i> , Fic. (1889). |
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Sub-Genus ii, *Culex* (sens. str.).

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| 3. <i>C. mimeticus</i> , Noé. (1899). | 6. <i>C. univittatus</i> , Theo. (1902). |
| 4. <i>C. modestus</i> , Fic. (1890). | 7. <i>C. pipiens</i> , L. (1758). |
| 5. <i>C. tipuliformis</i> , Theo. (1901). | |

Genus URANOTENIA, Arrib.

- 1.
- U. unguiculata*
- , Edw. (1913).

KEY TO THE GENUS *Anopheles*.

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|---|---|
| 1. Wings with pale spots on costa | 2. |
| Costa unspotted | 4. |
| 2. Costa with two spots of which the first is about two-thirds from the base and the second nearly apical in position | 3. |
| Costa with <i>one</i> (or if divided, <i>two</i>) small spots on basal fifth; three others distinct and larger along the costa and one at the apex | <i>A. superpictus</i> . |
| 3. 4th joint of hind tarsus darkened except at the extreme tip | <i>A. hyrcanus</i> (typical form). |
| 4th joint entirely pale | <i>A. hyrcanus</i> , var. <i>pseudopictus</i> . |
| 4. Wings spotted; the spots formed of tufts of scales at the cross veins and bases of fork cells; fringe with one pale spot near apex | <i>A. maculipennis</i> . |
| Wings and fringe unspotted | 5. |
| 5. Frontal tuft of white scales absent; mesonotum on middle and sides concolorous, its bristles uniform and nearly black | <i>A. algeriensis</i> . |
| Frontal tuft of white scales present; mesonotum darker at the sides, with pale hair-like scales medianly in addition to the usual bristles | 6. |
| 6. General colour of thorax dark-bluish grey. Anterior tuft of scales dense and white, the component scales broader, and extending back nearly to middle of mesonotum. Legs very dark bluish-black. In the ♂, the inner basal spine of side piece sessile and the outer simple... .. | <i>A. plumbeus</i> . |
| General colour of thorax from golden brown to dark brown; scales of anterior tuft brownish, more scattered and occupying less than one-fourth of the mesonotum. Legs brown. In the ♂ the inner basal spine stands on a process while the outer is double, both main branches being plumose | <i>A. bifurcatus</i> . |

KEY TO THE GENUS *Theobaldia*.

- | | |
|---|---------------------------|
| 1. Wings spotted | 2. |
| Wings unspotted (Culicella) | 3. |
| 2. Thorax paler; mesonotum with three narrow complete white lines; palpi (♂) sparsely clad, shorter than the proboscis by the length of the labellum. Cross veins usually separated (Allotheobaldia) | <i>T. longiareolata</i> . |

340 *Entomological Observations on Mosquitoes in Macedonia*

Thorax darker; unlined; palpi (♂) longer than the proboscis and clad, especially on the second joint, with shaggy hairs. Cross veins always in the same line (Theobaldia sens. str.)

T. annulata.

3. Larger, more robust and browner species. Proboscis (♀) with numerous pale scales; abdominal sternites with numerous pale scales; abdominal sternites with well defined anteriorly directed Λ-shaped dark markings on a paler ground. On the 8th sternite of the ♂ are 2—3 short erect spinose bristles on each side of the mid line on the distal half, while the extreme apical lobe is bare. The side piece of the armature about four times as long as the basal breadth

T. fumipennis.

A slighter, greyer species; proboscis (♀) practically black, sternites without distinct Λ-shaped marks, 8th sternites of ♂ with no unusually strong bristles on distal half and armed with a patch of short stiff bristles (6—7) on the apical lobe. Side piece a little over twice (7 : 3) as long as broad

T. morsitans.

KEY TO THE GENUS *Culex*.

- | | |
|---|-------------------------|
| 1. Abdominal bands or markings at base of tergites (<i>Culex</i> sens. str.)... .. | 3. |
| Bands apical (<i>Neoculex</i>) | 2. |
| 2. Tip of hind tibia (especially externally) white; side piece of ♂ armature with thumb-like process; antennæ abnormally bare | <i>C. hortensis.</i> |
| Tip of hind tibia dark; side piece (♂) without strong process; antennæ is normally clothed | <i>C. apicalis.</i> |
| 3. Costa of wings with elongate pale spots | <i>C. mimeticus.</i> |
| Wings unspotted | 4. |
| 4. Bands of tergites complete; first joint of hind tarsus of normal length, as long as the tibia | 5. |
| Bands medianly interrupted, reduced to lateral patches; first joint of hind tarsus shorter than the tibia; smaller, darker species | <i>C. modestus.</i> |
| 5. Fore and mid femora anteriorly with a pale longitudinal stripe | <i>C. tipuliformis.</i> |
| Fore and mid femora dark in front | 6. |
| 6. Hind tibiæ with pale stripe on outer side; abdominal bands white | <i>C. univittatus.</i> |
| Hind tibiæ dark except at the tip; abdominal bands creamy | <i>C. pipiens.</i> |

KEY TO THE GENUS *Ochlerotatus*.

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|---|----|
| 1. Hind tarsi with complete pale rings | 2. |
| Hind tarsi at most with scattered paler scales which may be aggregated towards the base of the first joint, but without forming definite rings | 4. |

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|--|--------------------------|
| 2. Joints of hind tarsus ringed only at the base (Ecculex) ... | <i>O. vexans.</i> |
| First four joints of hind tarsus ringed both at apex and at base; fifth joint entirely pale ... | 3. |
| 3. Colours of hind tarsus sharply contrasted black and white; thorax without definite lines; wing scales mainly black; abdominal tergites with narrow white basal bands ... | <i>O. pulchritarsis.</i> |
| Colours in hind tarsus brown and cream, with pale scales scattered over the darker areas; thorax usually with two nearly white longitudinal stripes; wings mottled conspicuously with lighter and darker scales ... | <i>O. caspius.</i> |
| 4. Legs bluish-black except at the base of the femora; femora with conspicuous white knee spot (Finlaya) ... | 5. |
| Legs not mainly blue-black; knees inconspicuous ... | 6. |
| 5. Scutellar scales narrow, several times longer than broad; abdominal tergites merely with white lateral spots ... | <i>O. geniculatus.</i> |
| Scutellar scales not more than twice as long as wide; flat and wide; tergites with white lateral spots and creamy basal bands ... | <i>O. echinus.</i> |
| 6. Postnotum with scales; wing nervures towards base and also on the apical third of costa pale yellowish. Abdominal scales of the ♀ all yellowish ... | <i>O. lepidonotus.</i> |
| Postnotum without scales; scales of tergites very evidently mixed ... | 7. |
| 7. Wings, abdomen and legs with numerous scattered pale scales. Abdominal bands white, simple transverse (♂, ♀) ... | <i>O. detritus.</i> |
| Pale scales on wings almost confined to the subcostal vein; tibiae and tarsi nearly black. Abdominal bands yellowish in the ♂; simple and transverse, but produced irregularly medianly in the ♀ to form a more or less continuous dorsal stripe ... | <i>O. rusticus.</i> |

It can hardly be doubted that additional members of this genus remain to be discovered in Macedonia. Excluding the few known species whose range is presumably subarctic, some of the following palæarctic or nearctic species may yet be found:—

- (a) *O. curriei*, Coq.; *O. mariaë*, Serg.; *O. zammittii*, Theo. These in the table would run down to *O. caspius*.
 (b) *O. punctor*, Kirby; *O. pullatus*, Coq.; *O. prodotes*, Dyar, and *O. communis*, De Geer, would run to *O. detritus*.
 (c) *O. maculatus*, Mg.; *O. annulipes*, Mg.; *O. excrucians*, Wlk.; *O. lutescens*, Fab., would run to *O. vexans*.

E. Martini (1919) has recorded the occurrence of two examples of *O. nemorosus*, Mg. "Aus dem Leschnica-Tal." This locality is probably near Petri, at the north end of the Rapel Pass, i.e., in Bulgaria. By "*O. nemorosus*" *O. communis*, De Geer may be indicated, but it is not really certain to what species Martini refers.

Anopheles maculipennis, Mg.

Anopheles maculipennis, Meigen, J. W. *Syst.*, vol. i, p. 11 (1818).

Distribution: Europe, North Africa, North-west Persia (Enzeli).

Abundant as an adult and with very varied larval haunts. Outnumbered only by *A. hyrcanus* along the lake sides or by *A. superpictus* in the hill streams from about midsummer. Along the sides of the more permanent larger streams, e.g., the Rendina, flowing at lower altitudes, it is the dominant anopheline throughout the season. Though everywhere common its numbers are greater in the spring, and the individual specimens are larger then. Unfortunately, sufficient importance was not at the time attached to the relative abundance of this and the following form, so that the seasonal prevalence of the type and the variety was not worked out. But from the few notes made it would seem that the type form appears earlier in the year. But more exact observation on this point is desirable.

Anopheles maculipennis, var.

This form has not yet been characterized but Mr. Edwards tells me that Major Christophers intends shortly to publish a description.

Distribution: Macedonia, Transcaucasia and Transcaspia, Syria, Palestine, Mesopotamia and Cyprus.

In Macedonia is widely spread as the type.

The most interesting point about this variety is its distribution which is evidently more eastern than that of the normal form. In South-east Europe the type and the variety overlap.

The points by which this form of the imago is separable from the type are clear, and so far as I have seen, constant. I was unable to detect any morphological differences among the *maculipennis* larva material examined in Macedonia. Mr. Edwards came to the same conclusion in regard to larval skins and pupæ from Palestine (Capt. P. J. Barraud) from which this variety was bred. But the eggs are said to be different.

Anopheles bifurcatus, L.

Culex bifurcatus, Linnæus, *Syst. Nat. Ed.*, vol. x, p. 603 (1758).

Distribution: Europe, West and South, North Africa, Palestine, Cyprus.

Generally distributed throughout Macedonia and common, though never forming any considerable proportion of the day's catch in hospitals or tents or dugouts. It is more abundant, or at any rate more noticeable in the early summer (April—May) and its larvæ are the first of any species of *Anopheles* to be found in the spring (Mikra in March). Hibernates probably in this stage in Macedonia as it is known to do in Italy, etc. The larvæ have a preference for wells or shaded surroundings but also occurred (Lahanah) in quite open streams. At Stavros (May) along the sides of a rather deep wooded ravine where no canalizing had taken place, larvæ of this species occurred in swarms with *Culex mimeticus* and *Neoculex* (both species) in shallow rocky pools filled with rotting leaves. Larvæ were also noted in casual water (Karasouli) and in marshes (Mikra, Mekes-Struma valley).

Anopheles algeriensis, Theo.

Anopheles algeriensis, Theobald, *Mon., Culic.*, iii, p. 21, ff. 8-9 and pl. VII (1903).

Distribution : Circum Mediterranean, Mesopotamia.

Probably more widely spread and commoner in Macedonia than the number of specimens determined might seem to indicate. Karasouli (August, 1917). Lahanah (September, 1917).

The larvæ were taken (with others of *A. bifurcatus*) in well shaded overgrown pools of a small stream at 58½ kilometres on the Seres road, Sept., 1917. The locality was indicated by Capt. Carnwath, R.A.M.C. The two species were not separated as larvæ, but a difference was noted in their subsequent development, one or two which I now believe to have been *A. algeriensis* reaching the imaginal state in three week. The others would probably have hibernated had they not been under laboratory conditions under which imagines were bred in late November. Some of these retarded larvæ were preserved and are definitely *A. bifurcatus*.

Anopheles plumbeus, Steph.

Anopheles plumbeus, Stephens, J. F., *Zool. Jl.*, vol. iii, p. 503 (1828).

Distribution : Europe.

Though doubtless distributed widely throughout Macedonia in suitable localities, this species was identified with certainty only from the Stavros district where it occurred in great numbers in May—June, 1918. It is vicious and persistent in its attacks, and I can personally vouch for its ability to bite through the double thickness of a thin canvas deck chair and one's pyjamas. At Stavros this species swarmed with *Finlaya geniculata* and *Anopheles bifurcatus* in a wood about three kilometres south-east from the mouth of the Rendina river. Both mosquitoes (*F. geniculata* and *A. plumbeus*) bit freely during the daytime. The wood referred to descends to within a few yards of highwater mark and on passing from sun-baked shingle to the shade a little higher up one was often attacked at once and as early as 2 p.m.

Anopheles superpictus, Grassi.

Anopheles superpictus, Grassi, *Atti R. Accad. Lincei, Rendic.*, vol. viii., part I, p. 560 (1899).

So far as one can judge any appearance of banding on the tarsi is invariably due to rubbing. *A. palestinensis*, Theo. (1903) would therefore seem to be an exact synonym.

Distribution : South-east Europe from Italy eastwards, Cyprus, Transcaspia, Palestine, Persia, North-west India (Quetta).

Although found during the summer generally throughout Macedonia and within a short distance of Salonica itself, one can appreciate the astonishing numbers of this species only after examining its breeding strongholds in the hill streams and its hibernating quarters in village stables, cowsheds, etc. When fed under laboratory conditions *A. superpictus* was found to bite more frequently than *A. maculipennis*. This species is burdened with a lengthy synonymy, but it does not seem to produce even moderately constant varieties.

344 *Entomological Observations on Mosquitoes in Macedonia*

Anopheles hyrcanus, Pall.

Culex hyrcanus, Pallas, P. S., "Reise durch verschiedene Provinzen des Russischen Reichs," vol. i, p. 475 (1771).

Distribution: Italy, to the Caspian, and southwards to Palestine, but extending in colour vars. across Asia to China, Japan, and the Malayan region. In Macedonia the type form and one variety occur together.

Though widely spread in Macedonia this species has its chief breeding places round the larger lakes and marshes. It was identified from the mouth of the Vardar to Karasouli, and thence along the Amatovo-Ardzan-Doiran chain of lakes to the foot of the Belesica Range. In the Struma valley its distribution was not worked out. The larval haunts are inshore in comparatively shallow water, and in the lakes particularly, some protection seems necessary against the attacks of small fish. In the autumn of 1917, below Galavanci at the north-east end of Lake Ardzan, such shelter was found in small spaces surrounded by drift of various kinds, and larvæ occurred in large numbers. A year later (August, 1918) not a larva could be found along the same stretch of foreshore (about two hundred yards), owing apparently to the fact that throughout the summer large numbers of horses and mules were watered or bathed there. The drift was thus constantly disturbed and the larvæ were apparently unable to thrive. *A. hyrcanus* probably occurs in the town of Salonica itself. A single ♂ was taken flying in sunshine at midday in a meadow beside the Galiko river, April 17, 1918. This is also the earliest record I have for the species. It remains on the wing until November. In the Vardar marshes it hibernates in stables, etc. The bite is severe.

Anopheles hyrcanus var. *pseudopictus*, Grassi.

Anopheles pseudopictus, Grassi, *Atti R. Accad. Lincei Rendic.*, vol. viii, part I, p. 102 (1899).

Distribution: Italy, eastwards to the Caspian, but probably as widely ranging as the type.

Macedonia: Karasouli, August, 1917, and probably elsewhere. The character given in the key appears to be the only reliable one for this variety.

Stegomyia fasciata, F.

Stegomyia fasciatus, Fabricius, J. C., *Syst. Anat.*, p. 36 (1805).

Distribution: Tropical and subtropical regions generally; always in the immediate neighbourhood of human settlements.

Macedonia: Only in Salonica itself, where it was common. Reports of its occurrence up country were, on investigation, invariably found to refer to some other species.

Ochlerotatus (Finlaya) geniculatus, Oliv.

Culex geniculatus, Olivier, G. A., *Encycl. Method. Hist. Nat. Insects*, vol. vi, p. 134 (1791).

Distribution: Europe.

Macedonia: "Caught in wood where it occurred in swarms, biting badly. Near shore Stavros, June 7, 1918."

The breeding places were in hollow plane trees, but even by the end of May these had dried up and no larvæ could be secured. This species was also sent to the laboratory (without any history) from the Hortiach Plateau (Capt. Valentine).

Ochlerotatus (Finlaya) echinus, Edw.

Ochlerotatus (Finlaya) echinus, Edwards, F. W., *Bull. Ent. Res.*, vol. x, part II, p. 133, January, 1920.

Distribution: Macedonia, Morocco and Algeria.

Macedonia: Stavros, one ♀. The type of the species deposited in the British Museum bred from larva from hollow plane, first week in June, 1918. A second worn ♀ was taken on the wing with *O. geniculatus*.

Ochlerotatus (Ecculex) vexans, Mg.

Culex vexans, Meigen, J. W., *Syst. Besch. Europ. Zweifl. Ins.*, vol. vi, p. 241 (1830).

Distribution: Palearctic, Nearctic and Oriental. In the latter region as far south as Ceylon. Not recorded from Africa, Australia or South America.

Macedonia: Two ♀, Keulike, South Galiko bridge, April 14, 1918. ♀, Bajirli, near Snevçe, August 15, 1918 (C. M. W.).

Ochlerotatus caspius, Pall.

Ochlerotatus caspius, Pallus, P. S., *Reise durch verschiedene Provinzen des Russischen Reichs*, vol. i, p. 475 (1771).

Distribution: Europe, North Africa and East to Gobi Desert, Arabia and Bahrein Island (Persian Gulf), Rawal Pindi (Punjab). In North and East largely replaced by *O. curriei*. Not found in North America.

Next to the Anophelines this species was the most troublesome mosquito in hospitals and camps, especially those on lower levels. At Kalamaria in 52nd General Hospital it was numerous in the wards, but though a few may have been bred within the bounds of the hospital, below leaking pipes, etc., the bulk came from the muddy foreshore about a mile away where in the spring a good deal of temporary water was to be found. The ova responded quickly to the spring rains and about a week after the first heavy fall multitudes of larvæ were to be found in water-filled cracks.

There may be, however, considerable intervals between the hatching of the eggs laid by parents of the same brood or even in the eggs of one female. One batch of eggs laid in October, 1917, hatched very irregularly and produced imagines up to the end of June, 1918.

On flat land near the sea this species occurred in thousands (Mikra, Vardar marshes, etc.), biting freely in bright sunlight.

Ochlerotatus pulchritarsis, Rnd.

Culex pulchritarsis, Rondani, *Bull. Soc. Entomol. Ital.*, vol. iv, p. 31 (1872).

Distribution: Italy, Macedonia, Persia.

Macedonia: Bajirli, near Snevçe (August 15, 1918) (C. M. W.).

The above example, the only one brought home in fair condition, was sent to the laboratory as "*Stegomyia*." I believe we received it from at least two additional localities, but the material was worn and not preserved.

Ochlerotatus lepidonotus, Edw.

Ochlerotatus lepidonotus, Edwards, F. W., *Bull. Ent. Res.*, vol. x, part II, p. 132 (January, 1920).

Distribution: Macedonia, six ♂, eleven ♀. In meadow near Galiko river, 41st General Hospital swept (April 26, 1918) (J. W.).

A large conspicuously pale species. Numerous in the original locality among long grass standing in water. A vicious biter even in sunshine. The eggs large, stout and heavy, sink on being deposited.

Ochlerotatus detritus, Hal.

Culex detritus, Haliday, A. H., *Ent. Mag.*, vol. i, p. 151 (1833).

Distribution: Europe, North Africa (on coast), one example from Central Asia (Chinese Turkestan).

Macedonia: ♀, 41st General Hospital, Galiko river; April 26, 1918, swept in meadow.

Taken also about the same time at Karabouroun. Doubtless common near the sea.

Ochlerotatus rusticus, Rossi.

Culex rusticus, Rossi, P., *Faun. Etrus.*, vol. ii, p. 333 (1790).

Distribution: Europe.

Macedonia: In meadow near Galiko river. 41st General Hospital swept. April 26, 1918, abundant.

Teniorhynchus richiardii, Fic.

Culex richiardii, Ficalbi, E., *Bull. Soc. Ent. Ital.*, vol. xxi, p. 50 (1889).

Distribution: Europe, Palestine.

Macedonia: Common, especially along the Vardar plain and valley. More abundant on lower ground, but occurring also at considerable heights, three hundred metres above Akukli on ascent to Hortiach plateau. When numerous it is a pest, and blood-gorged females were frequently brought in for determination with complaints of their severe bite. In large collections made at Karasouli (1917) and Janes (1918) not a single male was detected, and the sexes were taken together in tents only at Milovci, where the known breeding haunt was but a few yards away. The larva lives attached to the stems of water plants, but the pupa comes to the surface for the release of the imago.

T. richiardii constructs rather large egg rafts from which the larvæ on hatching drop to the bottom of the container and wander round till they die. No effort is made to return to the surface for breathing. The favourite breeding haunts of this species are densely overgrown back waters with a moderate depth of water (at least one foot).

Theobaldia (Allotheobaldia) longiareolata, Mcq.

Culex longiareolatus, Macquart in "Webl. et Berth. Hist. Nat. d'îles Canaries, Entom. Dipt.," p. 99 (1838).

Distribution: Circum Mediterranean and the Islands (Cyprus, Malta, etc.), extending east and north into Transcaspia, and south-east to the Punjab. To the west it reaches the Azores and Madeira, along East Africa it extends to the Cape (cf. *Culex tipuliformis*).

Macedonia: Abundant, The larva was often reared from small and dirty receptacles. In the town of Salonica it occurred in tins, water-butts, etc., with *C. pipiens* and *Stegomyia*. A large batch was found in November, 1918, in a tennis court marker filled by rain water with which some of the original wash was mixed. When nearly full fed, these larvæ were completely frozen—the water becoming a solid block. On thawing all recovered. A second frost a few nights later killed a number outright, and of the remainder that recovered, many subsequently died.

Theobaldia (Culicella) fumipennis, Steph.

Culex fumipennis, Stephens, J. F., *Zool. Journ.*, vol. i, p. 453 (1825).

Distribution: England, Holland, Italy, Macedonia.

Colonel Wenyon found both sexes, April 20, 1918, of this species numerous in a dugout behind 28th D.H.Q. on the Gumus Dere, a stream descending to the Struma valley. At Paprat, a few miles south of the previous locality and at a greater elevation, Captain P. J. Barraud also took some specimens, June 3-10, 1918, in a dried up well near a stream.

Theobaldia (Culicella) morsitans, Theo.

Culex morsitans, Theobald, F. V., *Mon. Culicid.*, vol. ii, p. 8, pl. xx, fig. 79 (1901).

Distribution: probably all Europe.

Taken by Colonel Wenyon with *T. fumipennis* on the Gumus Dere, April 20, 1918. Common, according to Captain Cassidy, at Janes, who sent several examples dated April 24, 1918; also from Hortiach, Capt. J. A. Valentine, during the summer, 1918. A severe biter.

Theobaldia annulata, Schrk.

Culex annulatus, Schrank, F. V. P., *Beytr. zur Naturg.*, p. 97 (1776).

Distribution: Europe, but represented by colour varieties in Palestine, Mesopotamia and Persia.

Macedonia: Abundant, especially at lower levels and in the spring. The larva seems to be less tolerant of impurities in its environment than *Allothobaldia*.

Culex (Neoculex) apicalis, Adams.

Culex apicalis, Adams, *Kans. Univ. Sci. Bull.*, vol. ii, p. 26 (1903).

Distribution: North America and North Europe extending east through Macedonia to Transcaspia.

Macedonia: Karasouli, Lahanah, in 1917, meadow by Galiko river, Yenidje Vardar, Janes, Gorgop, Lutra, Stavros, in 1918. Bred throughout the summer from the third week in April to the first in September. Abundant at Gorgop (Joyeux) and Janes (west).

Nearly all my numerous examples of this species are bred, but occasionally the adult was met with in dugouts during the search for *Phlebotomus*.

Culex (Neoculex) hortensis, Fic.

Culex hortensis, Ficalbi, *Bull. Soc. Ent. Ital.*, vol. xxxi, p. 217 (1889).

Distribution: France, Italy, Macedonia, North Africa (Algeria), Palestine, Transcaspia.

Found everywhere, but preferring shady streams as a breeding ground. Very abundant in the Lahanah district. The siphon of the larva, as in *C. apicalis* and *C. mimeticus* is extremely long and slender.

Culex mimeticus, Noé.

Culex mimeticus, Noé, *Bull. Soc. Ent. Ital.*, vol. xxxi, p. 240 (1899).

Distribution: Europe—Circum Mediterranean on north and east, and on the islands; Japan, Hong Kong and South China, India—Punjab and Central Provinces (Ootacamund).

An abundant breeder in hill streams with *Neoculex*, etc.

Culex modestus, Fic.

Culex modestus, Ficalbi, *Bull. Soc. Ent. Ital.*, vol. xxi, p. 93 (1890).

Distribution: Italy, Hungary, Macedonia, Palestine, Egypt.

I reared three ♂ from larvæ gathered near Vardino about October 10, 1917, at the exit of the River Azmak from Lake Amatovo. It also occurred in the Lahanah district.

The palpi of the ♂ are remarkably bare, even more so than in *C. hortensis*.

Culex tipuliformis, Theo.

Culex tipuliformis, Theobald, *Mon. Culicid.*, vol. ii, p. 325, f. 306 (1901).

Distribution: Teneriffe, Madeira, Crete, Macedonia, Palestine; from Egypt through the Libyan Desert into E. Africa, and as far south as Pretoria; Mesopotamia, Persia, India, Manipur, Bakloh (Punjab).

Macedonia, Lutra (August, 1918), Lake Hadji Geul. (October, 1918). An autumnal species occurring abundantly as a larva.

Culex univittatus, Theo.

Culex univittatus, Theobald, *Mon. culicid.*, vol. ii, p. 29 (1902).

Distribution: Circum Mediterranean (except North-west Africa) also Tropical and South Africa from Gold Coast to Madagascar. The more southern form, however, is possibly distinct.

Macedonia: ♂, five ♀, August 17, 1918, Lutra (C. M. Wenyon); ♀, September, 1917, Lahanah; in Hospital (J. W.). ♀, July—August, 1917, "Near Salonica," probably Karasouli.

Culex pipiens, L.

Culex pipiens, Linnæus, *Syst. Nat. Ed.*, vol. x, p. 602 (1758).

Distribution: Palæarctic and Nearctic, South America (Argentina), Africa (South and East), Madagascar.

To the varied breeding places of this species which I have already (1918) noted one may add that larvæ were taken at Lutra (Wenyon) in stream from sulphur baths. Similar notes have been made for the species in Italy. Also in warm stream (exact temperature not ascertained) below hot baths at Vetrina (December, 1918, J. W.).

The adult was frequently taken in tents.

Uranotenia unguiculata, Edw.

Uranotenia unguiculata, Edwards, F. W., *Journ. As. Soc. Bengal*, vol. ix, p. 51 (June, 1913).

Distribution: Italy, Macedonia, Palestine, Egypt.

The ascertained distribution of this species in Macedonia is entirely western. I failed to find it in or near the Struma valley, nor did any collector there meet

with this most interesting small mosquito. Beyond the Vardar Dr. Joyeux collected larvæ near Koritza and at Yenidje Vardar and Kastoria. I myself found it late in 1917 on the Vardar near Karasouli. On April 18, I secured larvæ in a meadow near the Galiko river, and the first imago resulted May 7, 1918—the earliest date I have for the species. Larvæ were also collected October, 1918, in great numbers from small pools at the side of Lake Adji Geul, above Narech. At this time the lake itself was still much reduced after the summer drought, but above the normal highwater edge at the south-east end were several pools in the clay. In these, larvæ of *Culex pipiens* and *C. tipuliformis* swarmed on the surface, and only a chance scoop revealed the presence of the *Uranotaenia*, practically all at the sides of their habitat among the roots of short grasses fringing the pools.

Dr. Joyeux believes the larva to be predaceous.

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CHRONIC EFFECTS OF INHALATION OF SUFFOCATING GASES.

BY CAPTAIN ALEXANDER MEARNS.

Royal Army Medical Corps, Experimental Station, Porton.

FROM a study of the varied reports published in the English, French and German languages, it would appear that far-reaching effects have been produced in a not negligible percentage of cases who have previously been in contact with suffocating gases, and, as will become apparent later, this percentage is probably underestimated at the present time. Chronic effects may be exhibited for a variable period of time after convalescence in those who have been subjected to a so-called severe gassing in the field or elsewhere, and also in those who, though never having undergone an acute gassing necessitating treatment, yet have been subjected to a slight intoxication or an absorption of noxious fumes more or less continuously for some time, as occurs among those engaged in work in gas factories, where the effects appear to be of a chronic nature from the beginning. Opportunity has recently presented itself whereby these effects could be studied in a considerable number of cases of the latter group. Though the conditions found do not differ greatly in the two classes, it becomes evident that the more progressive types of lesions are of more frequent occurrence among cases such as those examined. Hence, it may be of value to examine somewhat fully one or two of the sequelæ to gas poisoning revealed. The gases responsible for the effects are those of the suffocative series—chlorine, phosgene, chlorpicrin, trichlormethylchloroformate.

Cases can be divided into two main classes—first, those with physical signs and symptoms indicative of organic changes, and second, those in whom no such changes are found and therefore conveniently described as functional.

SEQUELÆ SHOWING ORGANIC CHANGES.

Respiratory System.

As would be expected the respiratory system shows the greatest degree of damage which results in three types with separate symptomatology and pathology. These types are distinct almost from the beginning, though it will be apparent that after many months symptoms of one type may be added to those of another.

(a) *Fibrotic Type.*—This condition is observed in cases as a sequel to an acute gassing but much more frequently among workers in factories with only a history of continual light absorption of gas, and seems chronic from the outset. Its occurrence was reported by a German author during

the war, and has been recognized by observers in Allied countries. The time of the onset varies, having been noted as early as the tenth week after a gas attack, while its presence may not become manifest till after many months, during which no abnormality could be found [1]. Among the cases recently examined the onset has been insidious, and only after the symptoms became well established could the physical signs indicate the exact condition of the lungs, which was revealed as a fibrosis at the hilum of the lung spreading along the bronchi and vessels.

Symptoms.—Shortness of breath on exertion is the first symptom in cases unaccompanied by bronchial catarrh, while in others the symptoms resemble those of a chronic catarrh, with which the condition undoubtedly commences. The peri-bronchial fibrosis once having been established, the main symptom is a dry, unproductive cough, often paroxysmal, worst in the morning with expectoration varying with the associated catarrh: the sputum may be blood-stained or even small hæmorrhages may occur, due to minute varicose capillaries in the bronchial wall. Shortness of breath, orthopnoea at night, faintness on exertion, deterioration in health and weight, associated digestive symptoms and occasionally cardiac symptoms—palpitation, retrosternal pain and tachycardia—are the subjective complaints; these latter—cardiac symptoms—are not always present but occur wherever other neuroses exist, viz., sweating, irritability, vague feelings of depression. An increased susceptibility to acute colds and influenza which may account for the constant catarrh, exists. Night sweats are uncommon.

Physical Signs.—The most prominent sign is the shallow type of breathing which becomes dyspnoeic on exertion. At first the signs elicited in the chest are somewhat indefinite, but on percussion areas of impaired resonance, not amounting to absolute dullness, are found over the hilum of the lung, most marked on the right side about the level of the fourth to fifth dorsal spines: these areas vary in size with the extent of the fibrosis, and spread in the direction of the bronchial tubes, while at the right apex anteriorly a similar small area can be discovered. Vocal fremitus and resonance are increased over these areas and the type of breathing is broncho-vesicular with slightly prolonged expiration: no tubular breathing is heard. Adventitious sounds vary with the associated bronchitis or emphysema. Examination of the chest wall for evidence of impaired ventilation and loss of elasticity can be made by a method studied fully by Hoover [2]—the tip of the third finger is placed on the second rib at the midclavicular line, that of the second on the third rib an inch farther outwards, that of the first on the fourth rib at the anterior axillary line. Normally, a deep breath being taken, an undulatory movement is felt on the chest, proceeding from above downwards. This method was adopted in the examination of recent cases, and the undulation was impaired, and in some cases lost. Separation or flaring of the costal margins during respiration is invariably noted, indicating restriction of the movement of

the diaphragm which probably accounts for the shallow type of breathing observed. This restriction of diaphragmatic movement is removed on making the subject inspire deeply when the costal margins are approximated, thus showing that it is not functional but probably defensive, as the taking of a deep breath gives rise to pain and cough. X-ray examination corroborates this restriction of movement of the diaphragm and also shows alteration in the translucency of the lungs, with areas of shadow corresponding to the thickened areas revealed clinically: these thickened areas spread out from the hilum into the lung substance like a fan and coincide with the distribution of the bronchial and arterial lines, with one or two sharply defined rounded areas, due probably to obliterated bronchioles. When much bronchial secretion is present, additional cloudiness is seen. The fact that the clinical signs and corresponding X-ray shadows are more marked on the right side than on the left may be due to the anatomical distribution of the bronchi—the left being less direct than the right. Small areas of greater translucency, corresponding to “*les images vacuolaires*” of the French writers, occasionally seen, are due to dilated smaller bronchi. The glands at the root of the lung are frequently enlarged due to chronic bacterial infection. On a long exposure to concentrated gas, the reaction is greater than that described and the lung parenchyma becomes affected by fibrosis, and the X-ray examination shows smaller areas disseminated throughout [3]. Frequently the symptoms of effort syndrome are present but no definite heart lesions can be found, though in severe cases, right-sided hypertrophy is observed.

So far as ascertainable the previous history and habits of the cases recently examined contained nothing that would obviously predispose to lung disease, and nasal obstruction tending to mouth breathing did not exist. The occurrence of peribronchial fibrosis, associated with obliteration and dilatation of the smaller bronchioles, bronchiectasis, collapse and emphysema has also been noted by Winternitz [4]. Experimentally, similar changes have been observed in dogs [5] and by Achard in other animals [6].

Discussion.—The changes that occur, therefore, are a progressive peribronchial fibrosis extending from the hilum of the lung outwards, in advanced cases, to the ultimate distribution of the bronchioles with or without associated bronchitis and areas of emphysema; there is also a loss of elasticity in the whole of the respiratory tract. This loss of elasticity recognized clinically has been shown experimentally to be due actually to loss or destruction of the elastic fibres throughout the lung. Incidentally it is to be noted that the earliest change in lungs developing silicosis is shown to be the same loss of elastic tissue [7]. It would seem that the restriction of the movement of the diaphragm—a factor to which not much attention has heretofore been directed—is of paramount importance, since it is noted in the early stages, where shortness of breath on exertion is the only symptom. It is reasonable to suppose that this restriction causes the

shallow breathing and consequent anoxæmia, and that in severe cases further alteration in the lung structure as in emphysema, causing an unequal distribution of air in the lungs, increases this oxygen want. Evidence of anoxæmia has been proved in several of the recent cases, by the beneficial effects of a sojourn in a high oxygen chamber, though the effect soon passed off; also by the effort syndrome symptoms frequently associated, which have been shown to be largely due to want of oxygen [8]. The orthopnoea at night is also explained by anoxæmia [9]. Physiologically alteration of the respiratory exchanges has been shown to occur [10]. The retrosternal pain so frequently complained of may be associated in some cases with a neurosis, but is more probably related to the areas where fibrosis commences, viz., at the root of the lung. Considering the large number of workers who do not develop this condition, it is evident that the inhalation of gases is only one factor in the production of fibrosis, that individual susceptibility must function in its occurrence and low bacterial infection may institute or continue its development. This individual reaction is somewhat analogous to that occurring in those working in dusty trades [11], and there is a curious resemblance between the condition of fibrosis above described and the early stages of fibrosis following on inhalation of inorganic dust, though it cannot be explained similarly by the deposition of the particles. It is not probable and, as yet, too soon to demonstrate whether the former ever progresses to the severe diffuse forms of the later stages of pneumokoniosis. Should it do so it would suggest that our present conception of the ætiology of lung fibrosis is far from complete, if not erroneous. A further resemblance is shown by the evidence, in severe cases, of dilatation of the bronchi sometimes present in areas where the fibrosis is most marked—root and right apex—especially common in pneumokoniosis [12].

(b) *Emphysematous Type*.—The existence of emphysema after gassing in cases with no history or evidence of previous lung disease, is shown in a few cases, though it is usually associated with, or a sequel to, the other two types—fibrotic and bronchitic. It has been noted, after a chlorine attack, in a man whose previous occupation in high altitudes could not have been accomplished unless his lungs had been absolutely healthy [13]. The respiratory and cardiac symptoms, the physical signs in the lungs and heart, in no way differ from those seen in cases of emphysema due to other causes, except in the greater rapidity of onset, and do not therefore call for detailed description.

(c) *Bronchitic Type*.—The exact significance of this type was first pointed out by Achard and Flandin, who also showed that most of the cases of supposed tuberculosis following gas inhalation were actually of this nature. They designated the type "pseudo-tuberculeux" and possibly some cases of those described above as fibrotic fall into this category. The symptoms and signs are so suggestive of tubercle that diagnosis can only be made after careful examination.

Symptoms.—These are in the main similar to those of bronchitis—cough, expectoration with or without hæmorrhages, marked loss of flesh, transient fever, shortness of breath, loss of general health—they vary with the atmospheric conditions. Examination of the chest reveals bronchitic râles generalized or localized to certain areas, harsh vesicular breathing, alteration of dullness on percussion. This condition is especially seen in those subjected to a continual absorption of fumes and therefore has been frequently seen recently in factory workers. In most cases the individual resistance is sufficiently high to overcome in the course of six to twenty-four months the condition, and convalescence gradually supervenes, but with those in whom it has lasted over a year there is a tendency towards emphysema, with the sequel of permanent invalidism. Physiological examination in such cases shows a permanent lowering of the respiratory exchange and consequent deficiency in respiratory functions [14].

Tuberculosis and Inhalation of Asphyxiating Gases.

The symptoms above described resemble so closely those occurring in chronic and subacute tuberculosis of the lung that the relation of gas poisoning to this disease has to be considered especially in view of the apprehension originally entertained. Many observations have been made to determine the rôle played by gas poisoning thereto, but since there is now a general agreement anent it, no detailed discussion is necessary, the main facts being stated. Achard and Flandin, early in 1916, reported that "On doit noter comme véritable complication le réveil d'anciennes lésions par l'intoxication. Les tuberculeux guéris font, soit rapidement, soit tardivement, des poussées évolutives souvent des hémoptysies après avoir absorbé du chlore. On aurait vu quelques cas de granulie chez des intoxiqués récents" [15]. Others have made the diagnosis of tuberculosis where in reality fibrosis of the lungs associated with dilatation of the bronchi was present. It is obvious that clinical observations cannot always determine the exact diagnosis in any given case and recourse to bacteriological and X-ray examination is essential; in addition, the history prior to gassing and the time relation of the latter to the onset of symptoms must be accurately known. From statistics information is not easily ascertained, so that it must be sought in a study of cases of tuberculosis occurring in those who have been gassed, and of cases of previous gassing in those suffering from respiratory troubles, including tuberculosis. Several thousands of gas cases have been examined for the frequency of tuberculosis by many clinicians whose reports are of especial interest and should be consulted for details. Bernard and Mantoux observed 1 case in 47 gassed [16], Achard 6 among 3,525 [17], while other observers have reported cases, Gimbert 8 [18], Boinet 14 [19].

Among 1,206 cases of lung complaints, Morichau-Beauchant observed only three in whom gas appeared to have any influence on the onset of

tuberculosis [20]. The influence of gas in initiating the disease was observed by Kindberg and Delham in one of 193 cases of tuberculosis amongst a thousand suspected [21]. Gimbert observed the influence in two per cent [22], Euthymiou 1·2 per cent [23]. Meakins and Priestley state that there is no evidence that chlorine gas poisoning renders a patient more liable to tuberculosis [24], and Elliott finds that among cases of tuberculosis very few have become casualties through being gassed [25]. The conclusion that presents itself after a study of these papers is that inhalation of gas has an extremely small influence on the occurrence of tuberculosis, but that in a few cases it may light up a focus of infection previously latent. An acute tuberculosis following gas, has been recorded in a few cases of previously healthy men running a very similar course, but nevertheless the possibility even in these cases of a latent focus cannot be ignored. Tapie [26] records the case of a man 36 years of age, healthy and with no pathological antecedents, who having been gassed, spits blood next day, is removed to hospital eight days later and dies of acute broncho-pneumonic tuberculosis on the twenty-fifth day after gassing. Post-mortem examination corroborates the diagnosis, cavities about the size of a small cherry being found throughout the lung. "Les lésions de l'arbre bronchique et du parenchyme pulmonaire qu'a pu créer l'absorption de gaz ont favorisé l'inoculation bacillaire massive et l'extension rapide du processus tuberculeux chez un sujet antérieurement robuste, peut-être porteur d'une lésion tuberculeux minime mais non immunisé par cette lésion." Other cases reported by Gouget [27], Ménétrier et Martinez [28], Tedeschi [29] and Achard [30] are very similar. In those where the inhalation of gas has preceded the diagnosis of tubercle by some considerable time, or who have been for long periods in weak concentrations, it is quite impossible to prove definitely a relationship of cause and effect, though there can be little doubt that intoxication by asphyxiating gases may in certain cases light up a latent lesion. The other possibility, viz., whether acute gas poisoning creates a condition in the lung predisposing or favourable to the development of tubercle, is decided by experiments conducted by Achard in forty guinea-pigs [31]. He states his conclusions thus: "L'expérimentation—si tant est qu'on puisse conclure du cobaye à l'homme—et l'observation clinique ne permettent donc pas d'admettre que l'intoxication crée dans le poumon un terrain particulièrement favorable à la localisation et à la croissance des tubercules." Among the cases recently examined no tubercular disease was discovered.

Digestive System.—Digestive troubles traceable directly to the action of gas are extremely few, though various symptoms indicative of atonic dyspepsia are to be observed on occasion, but these gradually disappear in the course of several months. Where they persist, as observed in cases examined, two factors in their causation are evident—the general weakness and malnutrition consequent on want of oxygen and, probably more

important, the absence of the massaging effect of the diaphragm due to its restricted movement.

Cardiac System.—No organic lesions have ever been traced directly to gas poisoning; though changes in the heart, hypertrophy and dilatation naturally follow on the lesions of the respiratory tract described.

SEQUELÆ WITH NO ORGANIC LESIONS.

Considerable attention has already been paid to a group of cases wherein little can be found clinically to account for the symptoms, and which must therefore be designated as functional; they occur especially among the "lightly gassed." Reference should be made to the original papers which contain full details of the observed facts and ascertained physiological data. Pearce [32], Reports by Barcroft and others incorporated in Medical Research Committee reports [33], Achard [34]. It is sufficient to state that they conform closely to cases of effort syndrome due—or more correctly, assigned—to other causes, and to the non-concussive type of shell shock [35]. The anoxæmia and symptoms that are present and which may last for a considerable time, yield to the treatment of sojourn in a high oxygen chamber, thus showing that they are not due to any gross physical change but are a definite gas neurosis. Like other so-called neuroses, the severity depends on the "instability" of the individual and is probably largely preventable. No doubt the condition might last almost indefinitely unless the adequate form of treatment is administered; and that treatment—oxygen—acts somewhat analogously to the "priming" of an internal combustion engine, which, although there is nothing mechanically wrong, will not function until this is done. The beneficial results of oxygen treatment recorded by Barcroft and others seems to be due to this "priming" action. What causes the necessity for this "priming" is not yet clear, though the possibility of hyperthyroidism cannot be overlooked.

CONCLUSIONS.

It has been here shown that there are two types of sequelæ to inhalation of asphyxiating gases.

(A) A type affecting primarily the respiratory system with definite progressive organic changes of the nature of a peribronchial fibrosis, emphysema and pseudo-tuberculosis.

(B) A type of gas neurosis, having the signs and symptoms allied to those of effort syndrome, without demonstrable organic changes.

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NOTES ON CASES OF HEATSTROKE OCCURRING IN BRITISH TROOPS STATIONED AT BASRA, MESOPOTAMIA.

BY CAPTAIN R. H. ALEXANDER.

Royal Army Medical Corps.

As Medical Officer in charge of the heatstroke wards at No. 3 British General Hospital, Basra, during the hot weather of 1920 and 1921, I have been responsible for the initial treatment of all the cases of hyperpyrexia admitted to, or occurring in, the hospital. As Mesopotamia, especially Basra, is one of the hottest stations to which British troops are sent, a few notes and statistics on cases dependent for their origin on a high temperature may be of interest to readers of the Journal.

Etiology.—The causal factor in all cases was extreme heat. Humidity did not appear to have the influence usually attributed to it (see Table II), neither did direct action of the sun's rays. During the summer months as little work as possible is carried on in the open between 11 a.m. and 4 p.m., and consequently in only a very few cases was there a history of exertion and exposure.

Basra has a much moister climate than most of the military stations in Mesopotamia, but it is dry compared with many of those in India. The wet bulb reaches 80° F. practically throughout the summer months but the relative humidity is low, especially in the afternoons. Most of the cases occurred in the afternoons. (See Table I.)

TABLE I.—*HOURLY ATTACK.*

Midnight to 4 a.m.	..	..	..	..	Nil
4 a.m. „ 8 a.m.	..	..	..	..	9 per cent.
8 a.m. „ noon	..	..	..	..	6 „
Noon „ 4 p.m.	..	..	..	..	46 „
4 p.m. „ 8 p.m.	..	..	..	..	36 „
8 p.m. „ midnight	..	..	..	..	9 „

The hot weather begins in April (although the thermometer may read over 100° in March) and the temperature gradually rises to over 120° in July and August. It is often still hot in September, but the nights are cool and by October the temperature is round about 100° and the nights are distinctly cold.¹

The daily temperatures as a rule vary quite considerably, a difference of 10° on two successive days being not uncommon. On the other hand heat waves (locally known as “date ripeners”) occur, when the temperature keeps up for about a fortnight at 124° to 128° F., and it is during these distressing periods that most of the heatstroke cases occur and that hyper-

¹ (Unless otherwise stated, atmospheric temperatures referred to are *maximum shade*).

pyrexia forms a very severe complication of other diseases. In 1920, of the twenty heatstroke cases, ten occurred in the "date ripener," August 14 to 21, when the average temperature was 124.9° F. This year the 12 days, July 12 to 23, averaging 125.7° F., were responsible for 29 cases out of a total of 35. More cases occurred toward the end than at the beginning of the "date ripener." Of the above 29 cases, 13 were admitted during the first 9 days, when the average temperature was 127.2° F., while during the last 3 days, although the average temperature had fallen to 121.3° F., there were 16 cases.

TABLE II.—METEOROLOGICAL OBSERVATIONS, BASRA, 1921.

Dates of observations	Dry bulb		Wet bulb Maximum	Wind movement	Number of heatstroke cases	Relative humidity at 4 p.m.
	Maximum	Minimum				
June 6	123.6	85.8	81.8	miles 121	1	% 19
June—all other days (average)	109.8	78.8	79.6	183	Nil	24
July—thirteen days on which heatstrokes occurred (average)	124.0	88.4	80.6	121	32	22
July—eighteen days on which no heatstrokes occurred (average)	119.2	83.7	86.0	135	Nil	22
August 14	118.9	85.0	86.0	149	2	22
August—all other days (average)	116.8	81.7	83.6	143	Nil	24
September (average)	111.1	74.6	79.8	115	„	30

Special Notes.

Highest minimum dry bulb, 94.3° F., on night of July 7-8.

No cases occurred on July 8.

Highest maximum wet bulb, 96° F., for twenty-four hours, ending 8 a.m., July 11.

No cases occurred on July 10 or 11.

Predisposing Causes.—The predisposing cause in fifty-seven per cent of cases was lowered vitality due to actual sickness or indisposition.

As regards the influence of alcohol, accurate data could not always be supplied, but from the information available fifteen per cent of the cases were certainly chronic alcoholics and eighteen per cent were total abstainers. In three cases an alcoholic bout immediately preceded the attack.

In only a few cases was there a history of constipation. The average age of heatstroke cases was 31.8 years as against that of 25.6 years for patients suffering from other diseases. Other causes of lowered vitality in the older men, as explained under "prognosis," were responsible for age appearing to be an important predisposing factor.

360 *Heatstroke occurring in British Troops at Basra*

Incidence.—See Table III.

TABLE III.—YEAR, 1921.
Incidence of Hyperpyrexia due to Heatstroke.

—	Number of cases	Strength	Incidence per 1,000	Number of cases, July	Incidence per 1,000, July	Remarks
British officers ..	1	..	..	1	..	British officers not as a rule admitted to No. 3 B.G.H.
Royal Air Force ..	3	..	..	2	..	..
Russian refugees ..	2	..	..	2	..	..
Civilians ..	1	..	..	1	..	..
Navy (H.M. ships anchored in Shat-al-Arab)	3	..	..	2	..	Also ten cases of heat prostration
British other ranks ..	25	964	26	23	24	..
<i>Incidence of Hyperpyrexia from other Causes.</i>						
British other ranks ..	37	964	38	32	33	..
<i>Incidence of Hyperpyrexia, all Causes.</i>						
British other ranks ..	62	964	64	55	57	..

Hyperpyrexia includes only cases with rectal temperatures above 107° F.

It will be observed that, in July, 1921, no less than 57 per 1,000 of the British other ranks in Basra had a temperature of over 107° F.

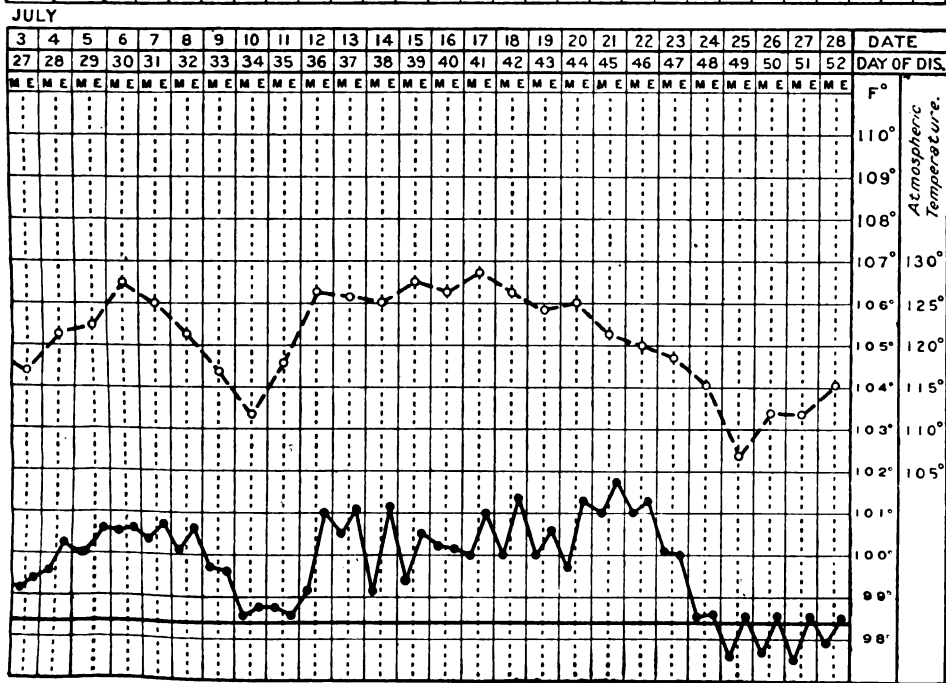
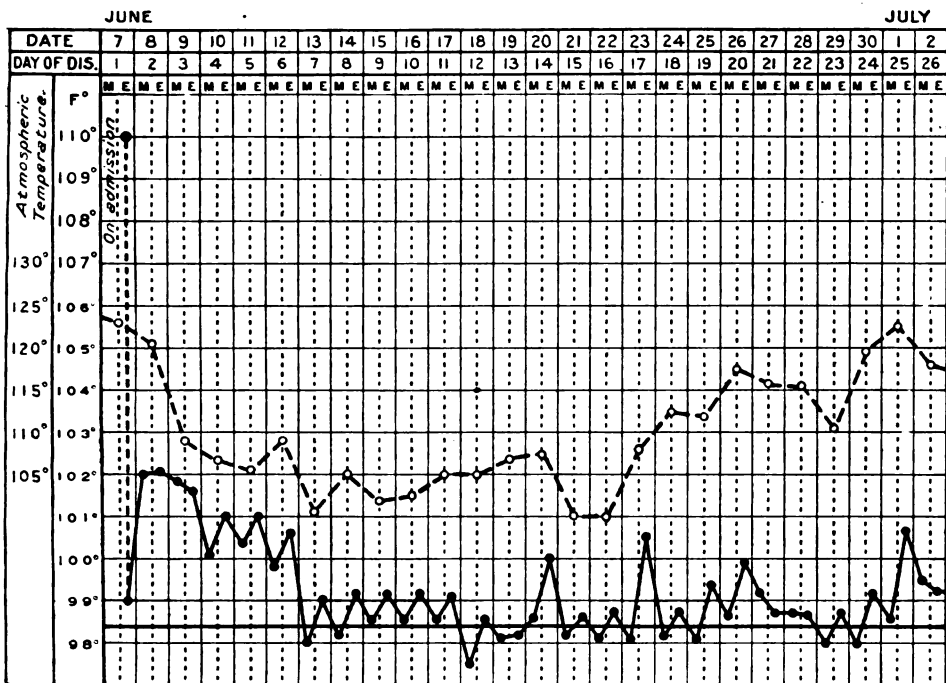
Symptoms.—All cases of heatstroke met with were of the paralytic type and exhibited the symptoms usually described. A high body temperature. Coma with contracted pupils and stertorous breathing. Diarrhœa with incontinence of fæces. On the temperature being reduced violent delirium and frequently severe convulsions followed. Cardiac depression leading in most of the fatal cases to œdema of the lungs was always present. If the acute symptoms passed off a tendency to hyperpyrexia continued for a few days. Cardiac debility remained a serious accompaniment of convalescence and an unstable temperature (see Temperature Chart No. 1), insomnia, loss of mental concentration and severe headaches persisted till the cooler weather set in.

Vomiting was seldom a symptom and in only a very few cases was there cyanosis.

A severe case of heatstroke admitted on June 7, 1921. Good recovery from acute attack. The very hot weather of July intensified the severity of the symptoms associated with convalescence.

Differential Diagnosis.—Stitt in his book on tropical medicine states that "The hyperpyrexial malarial paroxysm presents much in common with heatstroke" and that "There is no more difficult problem encountered in the tropics than the one of differentiating cerebral malaria from heatstroke."

TEMPERATURE CHART No. 1.



As Basra is a highly malarious district, these difficulties are constantly presenting themselves. The similarity was so great that it was considered wise to give each case of hyperpyrexia an intravenous injection of quinine even before the result of blood examination was known.

In 1921, thirty-five patients suffering from malaria had a temperature over 107° F. (rectal). With this temperature there were cerebral symptoms varying in degree from mild delirium to deep coma. All these cases were treated as heatstrokes (which included quinine intravenously) and the diagnosis was only made after the result of blood examination and of treatment had been ascertained.

Four patients suffering from sand-fly fever had a temperature over 107° and were slightly delirious, but were not in my opinion true heatstroke cases.

Seven cases of heatstroke occurred in patients in hospital—4 supervening on sand-fly fever, 2 on malaria, and 1 on cardiac degeneration.

The hyperpyrexia in the malaria and sand-fly fever cases only occurred in the hottest weather and might therefore have been attributed to heat and the patients diagnosed "heatstroke." I think, however, it is better to differentiate these cases from heatstroke and to defer the diagnosis until the result of treatment indicates the true nature of the malady.

A short description of each type of case may perhaps amplify these remarks.

CASE I.—SAND-FLY FEVER, WITH HYPERPYREXIA.

Patient admitted evening of July 20, 1921. Temperature 103.6° F. Blood negative for malaria. Diagnosed sand-fly fever. During afternoon of July 21, 1921 (when atmospheric temperature was 122.3°), temperature ran up to 107° F. and patient became slightly delirious. Rubbed with ice and temperature reduced. Delirium passed off and in the evening patient was quite rational, he was perspiring and complaining only of headache and pains in back and limbs. His progress thereafter was as a typical sand-fly fever.

CASE II.—MALARIA BENIGN TERTIAN WITH HYPERPYREXIAL PAROXYSM.

Patient admitted on July 21, 1921, as (?) heatstroke. Temperature 108.4° F. (rectal). Delirious. Iced. Blood film taken. Quinine fifteen grains given intravenously. Temperature fell and delirium passed off, but patient remained dazed. After half an hour temperature began to rise again, the patient was kept under wet sheets and his temperature kept below 104° . Later, temperature began to fall. Wrapped in blankets. Free perspiration. Examination of blood film showed large numbers of benign tertian parasites present. Quinine again given intravenously at night. Next day patient's temperature was normal and he felt perfectly fit. Quinine treatment by mouth continued and patient made uneventful recovery.

CASE III.—HEATSTROKE, SUPERVENING ON SAND-FLY FEVER.

Patient admitted morning of July 14, 1921. Temperature 103.4° F. Blood negative for malaria. Diagnosed sand-fly fever. Towards evening patient became delirious and his temperature ran up to 107.4° F., when he became comatose. He was iced and temperature gradually came down. Meanwhile violent delirium ensued requiring inhalations of chloroform. His temperature would not remain below 104° F. without wet sheets being applied. He did not perspire. Once during the night icing had to be repeated. He recovered consciousness next morning but throughout that day and the following night a tendency to hyperpyrexia was evident. He made a good recovery but during convalescence he suffered from post-heatstroke symptoms.

CASE IV.—HEATSTROKE, SUPERVENING ON MALARIA, BENIGN TERTIAN.

Patient admitted on July 19, 1921, with history of high fever during the night. Benign tertian parasites were found in the blood and quinine treatment started at once. Reacted well and temperature did not rise above 100° till afternoon of July 22, 1921, when it shot up rapidly to 109.8° F. accompanied by coma, etc. Iced, and quinine fifteen grains given intravenously. Temperature reduced but wet sheets were required for forty-eight hours to keep it from shooting up again. No malarial parasites were found in a blood film taken on July 22, 1921. Typical heatstroke convalescence.

CASE V.—CEREBRAL MALARIA, WITH HYPERPYREXIA.

Patient admitted on July 21, 1921, as (?) heatstroke. Temperature 110.2° F. Deep coma. Icing started at once. Blood film taken, and quinine fifteen grains given intravenously. Temperature was coming down gradually, but patient was very dangerously ill. He had spasms of opisthotonos ending with sudden collapse. Ether twenty minims injected subcutaneously, and artificial respiration, along with oxygen inhalation, continued for ten minutes. Patient was brought round and improvement set in. In a few hours he had recovered from these acute symptoms. Examination of the blood showed large numbers of malignant tertian malarial parasites present, many in crescentic formation, and quinine fifteen grains was again given intravenously. He had a good night, and quinine was given intravenously on the following day. Thereafter very satisfactory progress.

Prophylaxis.—"Hot-weather regulations" as regards clothes, hours for work, and sale of intoxicants were strictly enforced in Basra, and the dangers of contravening these orders were made known to the troops. An adequate supply of water and ice was arranged for, and the living quarters were well ventilated and provided with electric fans. Bath stations were provided at suitable localities.

These precautions were responsible for a remarkably low incidence of heat exhaustion, the total for 1921 being only six cases.

The bath stations proved very effective in the prevention of acute symptoms in numerous impending heatstroke cases and also in the prompt reduction of temperature in several severe cases before they were sent to hospital.

Patients in hospital being often debilitated and usually suffering from fever were carefully watched to protect against hyperpyrexia. The coolest wards were reserved for such cases, and any patient with a temperature of 103° , and who was not perspiring, was at once covered with a wet sheet, and very close observation kept on his progress.

Treatment.—On admission to hospital all cases of hyperpyrexia were taken to the heatstroke ward. This is a small ward in the centre of the main building, and it is the coolest in the hospital. It has three wire beds, on which only a waterproof sheet is laid. Above each bed a hose is fitted leading from a tank of iced water. Each case was covered with a sheet, and iced water played on to him, and his body rubbed with blocks of ice.

If his temperature did not fall after a few minutes' icing, an iced-water enema was given. In the cases where this was adopted, the results were highly satisfactory, but the procedure materially interfered with the taking of the rectal temperature for about half an hour.

During the icing a blood film was taken, and quinine bihydrochloride, ten or fifteen grains, given intravenously as a routine.

Camphor (two grains) was the cardiac stimulant used. It was given from the outset and continued hourly—two-hourly or four-hourly, as the case required. Digitalin $\frac{1}{100}$ grain was frequently given with it.

After the temperature was reduced to 103° F. per rectum, the patient was wrapped in blankets and hot-water bottles applied to the trunk and limbs; but in no case did perspiration set in, and when the temperature showed a tendency to rise again, wet sheets were substituted for the blankets. In no case did dangerous collapse follow icing—although the temperature generally fell to below 99° F. before it started to rise again.

For wild delirium chloroform anæsthesia was the only efficacious treatment, and once induction was complete further administration was stopped. For convulsions the same treatment was necessary, but anæsthesia had often to be maintained for a period of half an hour or more. Delirium and convulsions, however, frequently recurred, but in some cases, when the patient became quiet, morphia $\frac{1}{4}$ grain was found to control further attacks.

Lumbar puncture was practised in several cases, but the results were disappointing. Only once was the cerebrospinal fluid under pressure, and that was in a patient who remained dangerously ill and semi-comatose for four days; here lumbar puncture, on the third day, appeared to improve his condition, and a satisfactory recovery followed. The cerebrospinal fluid examined bacteriologically was normal.

In only a few cases was venesection indicated, and it was found necessary to cut right across a large vein, as the blood was very thick.

Prognosis.—Heatstroke, even in its severest form, is a very curable disease if prompt treatment be adopted. The longer the period that elapses between the onset of symptoms and adequate treatment the more grave becomes the prognosis.

Alcohol has a very marked effect on the prognosis. In the 15 per cent alcoholics and 18 per cent total abstainers referred to under "predisposing causes," the mortality was 100 per cent and nil per cent respectively.

Very severe convulsions indicate a bad prognosis. The maximum temperature above 108° F. apparently bears relation to mortality.

TABLE IV.

Maximum temperature (rectal)	Number of cases	Number of deaths
110° + F.	14	6
109°-110° "	12	5
108°-109° "	14	5
107°-108° "	12	2
Cases admitted dead where temperature had not been recorded	3	3

Previous health and occupation affected the prognosis markedly. A fairly large percentage of the personnel of the base is employed on clerical work. These clerks were, generally speaking, older and less fit than the men performing active work. The mortality in the former class was very much higher than in the latter.

The figures in Table V would suggest that age is an important factor in prognosis. It must be taken into account, however, that in the older men other unfavourable prognostic factors were frequently present, especially alcohol and sedentary occupation.

TABLE V.

Age	Number of cases	Number of deaths
20-30	16	3
30-40	11	5
40-50	6	4
50-60	2	2

The results of the cases in detail are shown in Table VI.

TABLE VI.—RESULTS.

	Recovered	Died
A.— <i>Rapid recovery from acute symptoms—</i> Eleven of these cases were treated at bath stations and hyperpyrexia was reduced before admission to hospital	27	..
B.— <i>Remaining dangerously ill for over twenty-four hours—</i> In three cases a favourable prognosis could not be made for over a week	7	..
C.— <i>Rapidly fatal cases—</i> Of these 6 were admitted dead 5 died within one hour 2 „ „ eight hours .. .. .	..	13
D.— <i>Ending fatally after several days illness—</i> 2 cases died on the 2nd day 1 case „ „ 3rd „ 2 cases „ „ 4th „ 2 „ „ „ 5th „ 1 case „ „ 11th „ .. .. .	..	8
It was most disappointing losing these cases as, although they appeared hopeless, one always trusted that they might rally as did the cases under heading B		

Disposal.—All cases were evacuated from the country in October. The majority of them appeared perfectly fit. I have no evidence of the after-effects of heatstroke but I expect that the periodic headaches and lack of mental concentration so universally found in the convalescing case would return on further exposure to extreme heat.

THE ROYAL ARMY MEDICAL CORPS FROM A JUNIOR OFFICER'S STANDPOINT.

(BY CAPTAIN H. G. WINTER, M.C.

Royal Army Medical Corps.

A LOVE of the Corps of which he has the honour to be a member and a spirit of *esprit de corps* amounting almost to an obsession should be part of the make up of a junior officer, because, eventually, when he attains to more senior rank, he will play a part in its evolution and because, by reason of his juniority, he holds appointments which bring him more intimately in touch with other branches of the Service and can by his example and opinions foster a spirit of respect.

Every man has, or should have, ambition, and an officer who applies for a Commission in the Royal Army Medical Corps has, presumably, a high opinion of the Corps or he would not join it; it rests with him whether he is to assist in maintaining it at the highest possible standard. The only way to attain this end is for every officer to have the welfare of the Corps at heart and to render himself, individually, as efficient as possible.

During the late war the best of the medical profession served in the Corps and a large number have obtained regular Commissions. These officers have not had the advantage of the probationary course at Millbank and Aldershot.

The spirit of the age tends rather towards "bolshevism" with its underlying selfishness, and any form of sentimentality is deprecated.

Esprit de corps is based on tradition. It follows, therefore, that an officer who knows nothing of the history of his Corps can not be expected to have any real affection for it. Very few junior officers of to-day know anything of this subject and, as a consequence, are very apt to ridicule and disregard the so-called "Customs of the Service," and are prone to view the whole question from a very superficial aspect; to ridicule the "traditions of the Service," which better men than they have learnt to respect. How many junior officers know anything about the Medical Staff Corps, or how many know the story of Major Brydon which has been immortalized in the famous picture to be seen in nearly every Royal Army Medical Corps mess, "The Remnant of an Army"?

A knowledge of the history of the regiment is part of the training of combatant officers and men and it will usually be found that the regiment in which this is most insisted upon is the smartest and most efficient. Many faults which we now deplore, such as unrest, indiscipline, etc., are due to lack of knowledge in this respect.

There is a tendency, engendered by the late war, for junior officers to adopt the attitude that they are doctors only and that any military

questions are pure waste of their professional time and capabilities ; if an officer holds these views it were better that he had never joined the Army and he would be well advised to apply for his release. It is not suggested that any officer should neglect the professional side, in fact it should be the aim of every officer of the Royal Army Medical Corps to be able to compete with the best brains in the medical profession, but at the same time he must remember that he is an officer of His Majesty's Army, and as such must have a thorough and detailed knowledge of all military routine and procedure.

No officer can be a success, more especially in the senior ranks, unless he has an intimate and extensive knowledge of the duties of his Corps and also to a less extent of those of other branches of the Service. This knowledge can only be obtained by seizing opportunities, and by work and enthusiasm whilst serving as a junior officer.

The majority of junior officers view what they call "Red Tape" with boredom, and instance the large amount of apparently unnecessary correspondence with which they are called upon to deal as a sign of inefficiency in their seniors. They do not realize that a large amount of this correspondence is necessitated by their own and their fellows' carelessness and ignorance of routine.

Criticism of senior officers by juniors is unfortunately very prevalent and is usually the outcome of inexperience on the part of the junior officer. It is subversive of all discipline and in the worst of bad taste. It should be severely discouraged.

That a knowledge of military procedure is necessary if the Corps is to keep its present position in the Army is borne out by history and it is an interesting paradox that as military efficiency increases so does the professional ability of the officer.

Originally a doctor was commissioned in a regiment, he became one of the regiment and wore the regimental badges and uniform ; his professional knowledge gradually decreased from lack of use as he never had a chance to keep himself up to date by doing hospital duty. Such officers as were doing hospital duty had no military standing, they did not command their men and had to refer all cases for punishment to a combatant officer. That even in those days the superior ability of officers and men of the Medical Service was recognized is instanced in the story of the combatant officer who, whenever a man of the Army Hospital Corps, as it was then, was brought before him, always said, "Superior Corps, superior pay, superior punishment, 28 days C.B. !"

The evolution of the Medical Service to its present position has been one long and arduous struggle against prejudice and obstruction. Officers of the Corps now have full disciplinary powers, not only over their own men but also over patients in hospital. They have a systematized service in which it is not only easy but imperative for every officer to maintain his professional knowledge at the highest possible standard.

In the last twenty to thirty years the status of the Corps has improved out of all recognition, and is now in a very strong position.

It has already been pointed out that the status of the Corps in its relation to other branches and to the Army generally has improved, especially with regard to the powers of its officers in military matters. To consolidate this position and to further it we must keep abreast of and even in advance of the seimprovements. We must put behind us old shibboleths. How often the term "M.O. i/c Troops" is written and referred to by officers of the Royal Army Medical Corps? Is not "Officer in Medical Charge of Troops" better and more in keeping with the position of the Royal Army Medical Corps Officer in the Army? Similarly, the term "Medical Arrangements of such and such an operation should be dropped and R.A.M.C. Operation Orders, etc.," substituted. Officers commanding military hospitals are still referred to and refer to themselves as "O i/c." The officer commanding a military hospital is in command of his unit (which includes patients) as much as is the officer commanding an Infantry Battalion. What would be the feelings of the regiment if its officer commanding was referred to as the "O i/c 2nd Bn.———Regt."? Again, orders are frequently issued, "The O i/c hospital will detail a medical officer, etc.,"; this on the face of it is absurd, the order should read, "The officer commanding ——— hospital will detail an officer etc.,"; "G" Branch would not order the commanding officer of an Infantry Battalion to detail an *Infantry* officer.

The administrative powers of a S.M.O. have long since been curtailed, and the term "P.M.O." has given place to "A.D.M.S." yet the appellation "S.M.O." still persists. The A.D.M.S. is now responsible for all administrative details in his area, but where that area is a large one and scattered, it may be necessary to appoint a senior officer, stationed on the spot, to exercise local control over the officers in medical charge of troops, and with power to decide small details which may be referred to him by the local commander, such questions being too urgent or too trivial to form the subject of correspondence with the A.D.M.S.

Terms such as those objected to above are all very well in civilian life. The term "M.O.H." is correct, and sounds correct with reference to a civilian Government appointment, but as far as military life is concerned, it will not do, and "S.S.O." which has now been superseded by "D.A.D.H." is employed instead.

These details may appear trivial and to have been unduly laboured, but the psychological effect of constant use of the old and obsolete terms is retrograde.

There are certain appointments which may be held by a junior officer which will give him invaluable experience; the appointments referred to specially are: Deputy Assistant Director of Medical Services, Registrar, Company Officer, etc. If it is his fortune to obtain one of these appointments, it should be the aim of an officer to make the most of the opportunities given him.

It is, or should be, the ambition of every officer in the Corps one day to attain the supreme appointment of Director-General. No man can be a successful Director-General unless he has an intimate and personal knowledge of all Corps duties; he must, therefore, from the commencement of his service, grasp every opportunity to fit himself in this respect.

After one year's appointment as Registrar, an officer should be *au fait* with every detail of hospital administration, and should be able in later years, when inspecting hospitals, to place his finger on any fault that may exist, and advise the officer commanding as to the correct procedure, in detail.

The same remarks apply to the appointment of Company Officer. In this connexion it may be observed that officers of the Corps do not, perhaps, have the same opportunities as officers of combatant units of knowing their men. This is all the more reason why an officer of the Royal Army Medical Corps should strive to know his men and further their condition. If an officer does not know his own men, their troubles, mode of life, etc., he cannot, as a doctor, expect successfully to treat patients who are soldiers themselves.

The age in which we live is very mercenary, and is tending to become more so; consequently, if we look into the reasons for most regulations, etc., we find that nearly all have a financial basis, and are formed primarily to safeguard the State from a monetary point of view. A thorough knowledge of the latest regulations is therefore necessary if an officer is to save his own pocket. Some officers pride themselves on their knowledge of regulations governing their own pay and allowances, and usually get all that is due to them; these same officers may find themselves heavily out of pocket through ignorance of a regulation which did not happen to be in the Pay Warrant or Allowance Regulations. Further, a soldier looks to his Commanding Officer for guidance in such matters.

The majority of existing books of regulations were last revised in 1914 or earlier, but vast quantities of amendments have since been promulgated in Army Orders, etc., rendering the original books practically useless. Every officer is ordered to keep his books amended to date, but very few do so. It costs very little time and money to make the amendments, and every officer is advised to do so personally, as by the mere fact of making the amendments he must increase his knowledge. Monthly Army Orders can be obtained from the printers for the sum of 4s. a year, post free, at home or abroad and, provided that the books have once been brought up to date, the time taken is at most two hours a month.

An officer of the Corps should not confine himself only to the regulations, etc., affecting his Corps, but should at least know something of the contents of other books, such as the Barrack Services Regulations, the Regulations for Royal Engineer Services, the Royal Army Service Corps Training Manual, etc., for questions are frequently arising in a unit administered by the Royal Army Medical Corps, which can be easily and

quickly answered by anyone with a general knowledge of these publications, and who knows where to find the particular point at issue dealt with: by so doing he saves a certain amount of unnecessary correspondence and, incidentally, possibly his own pocket.

It is not the fortune of every young officer to hold junior administrative appointments, and all junior officers should, therefore, make the most of opportunities afforded them of gaining knowledge whilst attached to the various offices of the hospital in which they are serving, as laid down for part of their training.

Many officers order diets, etc., for patients without in the least knowing what these diets contain, and would probably be surprised if told that the constituents of such diets were all laid down in the Allowance Regulations: one consequence of this ignorance is unnecessary extravagance in extras. Others, perhaps, are more conscientious and know what they are ordering, but consider that as far as they are concerned, their knowledge should end there, that it is the duty of the Quartermaster's department to do the rest; these officers must remember that they will probably be one day in command of a hospital, and must know all about and be responsible for diet; summaries, and abstracts, etc. It will be much easier for them, and will save them much worry and annoyance if they have learnt all about it in their youth.

No officer should shirk responsibility, and, further, no officer can take responsibility unless he is sure of his ground, which is tantamount to saying that he has a thorough knowledge of his regulations.

Many a failure can trace the primary cause of his downfall to a lack of knowledge of regulations; such a man may have had a bad set-back at an early period in his career as a result of crimes of omission or commission resulting from his ignorance of existing instructions; it is possible that he may have thought that he was harshly dealt with, but however that may be the fact remains that he lost his self-confidence and refused to take any responsibility that was not absolutely forced upon him. Such an officer is foredoomed to failure, he cannot be trusted to act in an emergency, and is therefore useless as a senior officer in the Army.

Take any amount of responsibility, provided you are sure of yourself and of your ground; the more responsibility you take, the more confidence you will gain; you cannot expect to become a successful senior officer if you shirk as a junior.

The exercise of tact and a knowledge of human nature are essentials in a doctor; the former is largely a matter of early training, and perhaps to a certain extent of temperament, but the latter can only be gained by experience; these two attributes are even more essential in an officer of the Royal Army Medical Corps. The game of poker is recommended as excellent early training, not because of the element of bluff required but as an exercise in judgment of character.

The officer in medical charge of a battalion has a great deal of power

if he knows how to use it. Usually the end can be gained by a tactful handling of the situation but occasionally it may be necessary for the officer to exert his powers. Every situation must be judged on its merits and the officer himself is the one who can decide when it is necessary to use force. If he is wrong in his decision he may possibly gain his point but will very probably make his own position in the regiment uncomfortable and will not increase the respect of the other officers for his Corps. If, on the other hand, he invariably uses tact and discretion and only brings pressure to bear when absolutely necessary, he and his Corps will be respected.

A junior officer holding a Staff appointment must for ever be on his guard against undue familiarity and disrespect towards senior officers in his area; he must not forget that he is junior in rank and experience and that senior officers, very naturally, resent being patronized by a young officer whose head has presumably been turned by his position; moreover, one of them may be that junior officer's Commanding Officer.

Much has been said about the necessity for a thorough knowledge of regulations, some, moreover, refer to the Regulations for the Army Medical Service as the Royal Army Medical Corps officer's bible, but at the same time the regulations should be interpreted in a kindly spirit. It may, for instance, be quite clearly laid down that only such permanent civilians whose injuries or disease are attributable to service are entitled to treatment in a military hospital but at the same time no one could or would object to the officer in command of a military hospital admitting a man who has no connexion with the Army but who was run over and seriously injured outside the hospital. As an illustration may be cited the actual case of the officer in command of a military hospital, situated five miles from the nearest civil hospital, who, when told that a woman had been run over by a train just outside the hospital, said, "If she is alive, she must be taken to the civil hospital, but if she is dead, humanity dictates that we place her in the mortuary." This woman was seriously injured and should have been admitted to the military hospital, in spite of the Commanding Officer's ruling; in actual fact she was admitted straight away much to his annoyance. That Commanding Officer was adverse to taking the responsibility of admitting the woman with possible complications as to covering authority afterwards; the officer who admitted her did so on his own responsibility; he realized that she had not been seen by his Commanding Officer who could not therefore know how serious her condition was and that, if she was not admitted, and died on the way to the civil hospital, serious trouble would result.

Regulations are framed primarily to cover all contingencies but circumstances frequently arise in which it is not possible or practical fully to comply with them. In such cases the officer must act on his own responsibility and apply for covering authority for his action afterwards. Cases of this nature are of frequent occurrence but the letter applying for

authority is often so badly constructed that a totally false impression is conveyed.

Official correspondence should always be brief and to the point and should contain nothing but the facts, and *all* the facts, bearing on the case at issue. This does not mean that it should be so curt as to be discourteous. The letter or memo should commence with the request for what is required and then should state the reasons. A long-winded and disjointed rigmarole containing subject matter having no bearing on the case and full of such phrases as "I believe" or "So I understand" is quite useless and is only annoying to the person to whom it is addressed. Separate questions should, as a rule, be made the subject of separate communications.

A study of regulations is not such a dry and boring occupation as might at first be imagined, in fact, the deeper one goes into the subject the more interested one becomes. One would not expect to find quotations from Shakespeare in an official publication, yet such a quotation does exist in no less a volume than the "Manual of Military Law"!

There are many excellent and extremely useful unofficial books on military subjects which will be found of great use to an officer who takes his subject seriously. The following, amongst many others are recommended: General Goodwin's book on Field Service Notes for Royal Army Medical Corps (although a little out of date in places, as it was written in 1913), "Guide to Official Correspondence and Letter Writing," Gale and Polden; "Guide to Keeping Company Accounts," by Colonel Todd, R.A.P.C.; "Guide to Courts of Inquiry," "Courts Martial for Presidents and Members," "Banning's Military Law," etc., etc.

In conclusion, every junior officer is exhorted to think of the Corps he has joined, to learn something of its history and traditions and endeavour to gain at least a superficial knowledge of Army Regulations. If he does so his pride in the Royal Army Medical Corps is bound to increase and he will be jealous for its honour. His interest in his work will develop and he cannot fail to gain in efficiency.

Clinical and other Notes.

THE QUINIDINE TREATMENT OF AURICULAR FIBRILLATION.

BY MAJOR J. H. SPENCER, M.D.Lond., M.R.C.P.

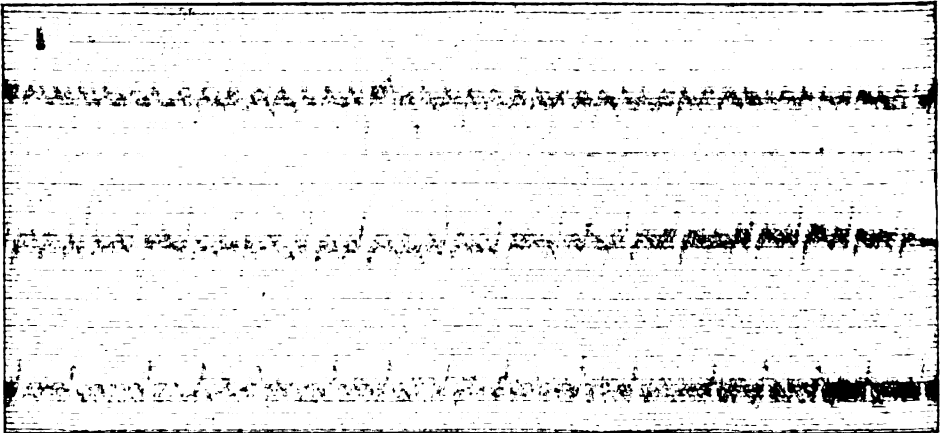
Medical Specialist London District Royal Army Medical Corps.

THE writer is indebted to Dr. T. F. Cotton, of University College Hospital, Consultant in Cardiology to Queen Alexandra Military Hospital, for permission to publish the notes and tracings of the undermentioned case which was treated at the Queen Alexandra Hospital under his supervision.

Colonel N., aged 46, was admitted December 15, 1921, with the history of having crashed from an aeroplane in Egypt on August 15, 1921, sustaining severe injuries to the pelvis and a traumatic right-sided pneumothorax.

Cardiac irregularity was present from shortly after the date of the injury and persisted.

On examination at Queen Alexandra Military Hospital the polygraph tracings showed an arrhythmia which suggested auricular fibrillation. There was no evidence of gross organic heart disease and no history of illness likely to cause any disease of the heart. Patient was sent to Dr. Cotton for further opinion, and the electrocardiogram A confirmed the condition of auricular fibrillation.



ELECTROCARDIOGRAM A.—Fibrillation.

Quinidine treatment was begun on January 9, 1922. The patient having been free from administration of digitalis for seven days, a dose of 0.2 gramme quinidine sulphate (in cachet) was given to determine if any quinine sensitiveness was present. The following day 1.2 grammes of quinidine sulphate were given in three equal doses at 8, 11 and 14 hours.

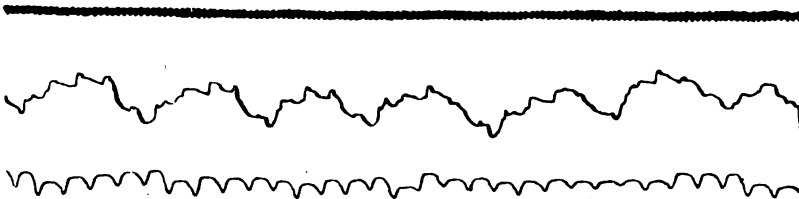
On the second day of treatment the polygraph tracing (P1) showed the auricle

still fibrillating. Two grammes of the salt were given in five equal doses on this day at 8, 11, 14, 18 and 20 hours. The next day (third day of treatment) the pulse and apex beat were both steady and regular at sixty-six per minute with no discoverable arrhythmia (see polygraph tracing P2). Three doses of the salt (0.4 gramme each) were again given on this day.

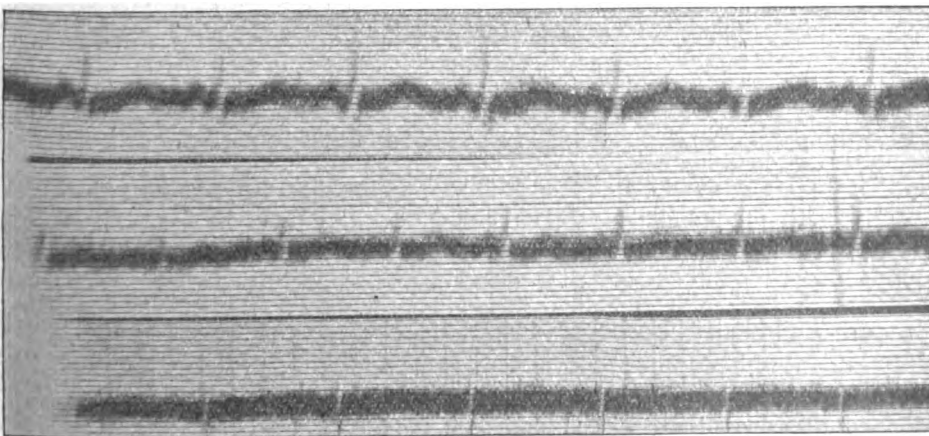
On the fourth day of treatment the pulse and apex beat were still regular at sixty-nine to seventy per minute.



POLYGRAPH TRACING P1.—Fibrillation.



POLYGRAPH TRACING P2.—Normal rhythm restored.



ELECTROCARDIOGRAM B.—Normal rhythm restored.

On the fifth day of treatment the electrocardiogram B showed the auricle to have resumed its normal rate and to be transmitting normal impulses.

As the patient was to have a severe operation to the hip-joint it was considered advisable to continue 1.2 grammes of the salt daily up to the date of the operation. He was, however, allowed up and was able to take exercise from the fifth day of treatment.

The operation was performed on the fifteenth day from the commencement of treatment, and no relapse of cardiac condition occurred as a result of it, nor has there been any arrhythmia up to date.

A feature of interest in the case was the immediate disappearance of very troublesome and resistant gastric flatulence immediately the normal cardiac rhythm became restored. This treatment should never be attempted without daily polygraph tracings being taken, and access to the electrocardiograph in the hands of a specialist in cardiology is very advisable.

NOTE ON THE WASSERMANN REACTION CARRIED OUT ON AN UNSELECTED BRITISH MILITARY GARRISON.

BY CAPTAIN D. W. BEAMISH.

Royal Army Medical Corps.

It is regretted that time and opportunity prevented me from carrying out more work on this subject as I particularly wanted to perform the test on the military followers of the garrison. Unfortunately I was transferred to another station where the opportunity did not present itself.

However in case it may be of slight interest, I am recording my results.

Iyengar carried out the experiment on 400 totally unselected male Indian adults of various castes, religions, and occupations; he obtained a positive result in 88 out of 400 cases, or a percentage of 22.

The British garrison of Kasauli where the experiment was carried out consisted at the time of roughly 170. It included the Central Clerk's School, which in turn included men from various units; also the depot details who were mixed, and lastly the detachment of the battalion which was stationed there at the time.

Out of these I did the test on 145 which I think, may be considered representative of the garrison.

The ages ranged from 18 to 38, the average total service was four years and two months. About sixty per cent had seen active service. I did not have time to go into details of each man's previous medical history. Out of the 145, four positive results were obtained. None gave any history of previous syphilis, nor were there any signs of active disease present. One man who gave a result + 1 was an old malaria case. The other three had no previous illnesses of interest. Bloods were taken into Wright's capsules.

The technique employed was method No. 4 described in the Medical Research Committee Report (1918).

TABULATED RESULTS.

Total examined	Number of doses of complement deviated				Totals		Remarks
	0	1	3	8	Positive	Negative	
145	141	2	1	1	4	141	One man showing + 1 was an old malaria case



FIG. 1.

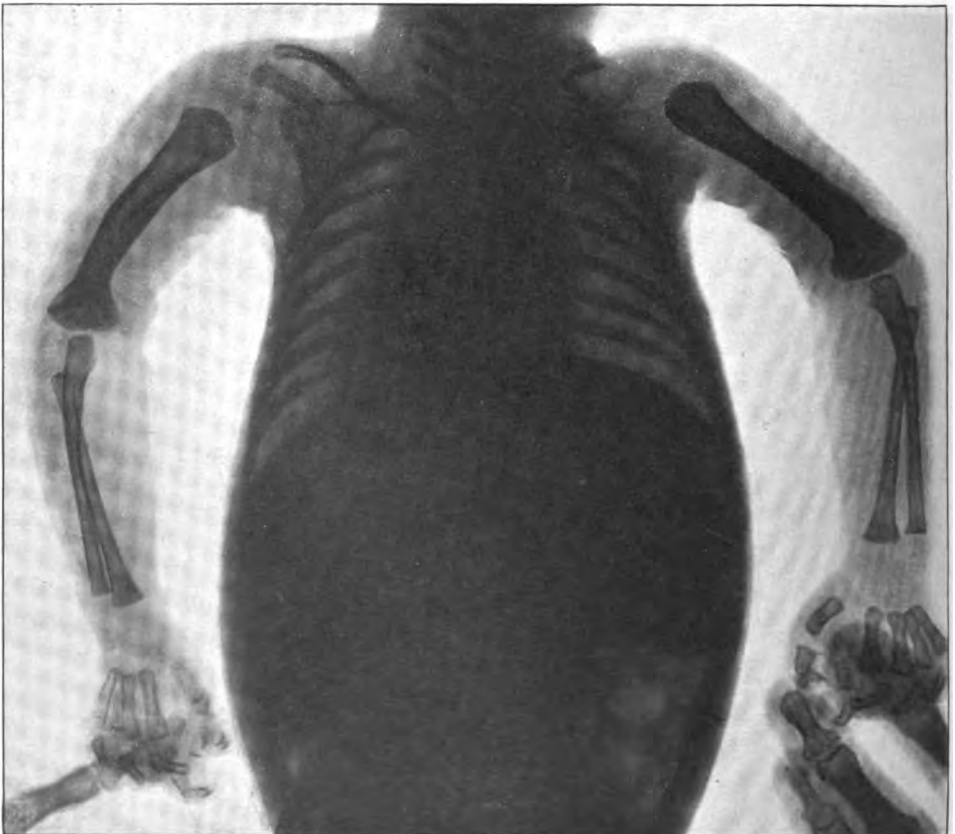


FIG. 2.

To illustrate "Three Unusual Cases of Fracture of the Humerus," by Lieutenant D. C. BOWIE,
R.A.M.C.

CONCLUSIONS.

This result is not altogether satisfactory on account of the smallness of the numbers, but nevertheless shows a certain percentage of positive results of the Wassermann reaction in an unselected garrison. In this case I think the percentage is smaller than might be expected. If a more exhaustive series of tests could be made the result might prove more instructive.

I wish to thank Dr. Raman Pillai for helping me to get through the numbers.

REFERENCE.

K. R. K. IYENGAR. "Studies in the Wassermann Reaction No. 1," *Indian Journ. of Med. Research*, vol. vii. No. 2, October, 1919.

THREE UNUSUAL CASES OF FRACTURE OF THE HUMERUS.

By LIEUTENANT D. C. BOWIE.

Royal Army Medical Corps.

THESE cases occurred lately on the civilian side of "B" Section, No. 82 General Hospital, Constantinople, and are of interest, in one case, because of the excellent result obtained by Nature, without interference.

(1) The first case was a torsion fracture of the humerus in a very powerfully-built man, aged 32. This man, with his elbows on a table before him, and his fore-arms flexed, was trying to separate his fists, against the resistance of a friend, whose part it was to oppose this action. When the full force was developed against the full resistance, the patient's right humerus snapped, and when a radiogram was taken by us a spiral fracture was shown in the lower third of the bone.

This patient had never been ill in his life before, and this was his first broken bone.

Treatment was by extension on a Jones' arm splint, with massage and movement from the first week, and perfect union resulted in the normal time.

(2) The second case was that of a "crack" base-ball "pitcher," who, while pitching in a match for the first time for four years, fractured his right humerus in delivering a fast swerving ball. The radiogram showed this fracture to be spiral in nature and to be situated at the junction of the middle and lower thirds of the bone. Treatment was similar to that laid down in the first case and he went out with a humerus firmly united in good position, fifty-eight days after his accident.

Twenty-six days later, I readmitted the same man with another fracture of the same humerus, this time clinically above the former fracture. He said that he was in a fight and had tensed up all his muscles to land an upper-cut on his opponent, but he is positive that he never landed the blow, because his arm, so to speak, broke in transit.

The radiogram, this time, showed the former fracture firmly united, and a fresh spiral fracture in the mid third of the humerus, having no connexion with the old fracture.

Treatment was on the same lines as before, and sixty days after his second accident he went out with the fracture firmly united and with full range of movements.

This man never had a broken bone until the time under consideration, and the only illness he ever had was an empyema four years previously.

(3) The third case was most interesting, as showing the perfect result of non-interference in a fracture in an infant.

The child was brought in three days after birth with a fracture of each humerus in its middle. These fractures were caused during rapid delivery from a dead mother, and on admission the child's arms were bound to its sides. Often, however, in the following days they were found waving about quite freely, when the child managed to wriggle free of the binder.

The first photograph (fig. 1) was taken when the child was 15 days old, when, clinically, union was very firm in both bones. The bad position and the great callus formation are well shown in the plate. The union was so firm that when a general anæsthetic was administered a few days later, for the purpose of breaking down the united fractures, this could not be accomplished without the exercise of unjustifiable force. A certain degree of moulding was, however, attained.

We were fortunate enough to get the second photograph (fig. 2) when the child was 68 days old, and the perfect alignment and general rounding off in the fractured areas are well seen.

It is to be noted that no other of the child's bones was broken, and that the fractures were most probably due to direct violence during delivery, as was told us in the history originally.

I have to thank Colonel Inkson, V.C., D.S.O., A.M.S., A/D.D.M.S., British Army in Constantinople, and Major J. Donald Gunn, Royal Army Medical Corps, officer in charge Surgical Division, for permission to publish these notes.

ENTOMOLOGICAL NOTES: ON A MUSCID FLY BREEDING ON A SHIP AT SEA.

By MAJOR J. E. M. BOYD, M.C., F.E.S.

Royal Army Medical Corps.

DURING a recent voyage from England to India, on a hired transport, it was found that flies of some species were increasing on board daily, and as the ship was a considerable distance from land, it was evident that these flies were hatching out on board.

Some adult specimens were caught, and proved to belong to the genus *Musca*—species as yet undetermined.

A newly-emerged specimen, with its wings undeveloped, was caught in the officers' urinal on C deck, but it escaped before its wings were fully grown. The urinal on which it was found was of the usual basin type with slate partitions. Balls of naphthalene were in the urinal, with a constant flow of water. Adjacent to the urinal were five w.c.'s and three baths, all contained in one large compartment; the partitions between each did not reach either the floor or the ceiling of

the larger compartment. The larva from which this fly had developed must have lived in this, as no other likely breeding place could be found near by. This compartment was said to be washed out daily with salt water.

One of the stewards was asked if he had noticed flies before, and he stated that the ship always carried what he called "sea-flies," and that these increased in number as the voyage progressed; at first, after the ship had been cleaned in dock, they were few in number, but others appeared later, chiefly in the pantry.

From personal observations made on board, it was seen that the numbers certainly increased as time went on, but unfortunately an attack of influenza cut short further investigations until Port Said was reached.

A varied assortment of insects visited the ship whilst in harbour at Port Said, and it was difficult to distinguish "residents" from "visitors," but as the voyage progressed, the visitors gradually disappeared, *Musca* remaining the most common genus until Bombay was reached.

On a previous voyage large numbers of *Calliphorinæ* (blue bottles) were seen, but this was found to be due to some meat having been exposed, owing to a faulty refrigerator pipe; but the genus *Musca* appears to breed constantly, and, judging from this and other things noticed on board, there was evidently some flaw in the sanitation of the ship. Several likely breeding places were examined, but no larvæ or pupæ could be found.

It might be of interest to know whether the breeding of *Musca* on ships is a common occurrence, or is it peculiar to this one ship, which for obvious reasons shall be nameless.

In the Suez Canal large flights of male *Chironomidæ* and *Culicidæ* followed the ship, but only one female mosquito, *Culex* sp., was caught on the vessel.

Other insects found on board were cockroaches, fleas, bugs, and *Phthirius pubis*, whilst of the acarinae *Sarcoptes scabiei*, var. *homini*, appeared in a few cases.

NOTE ON THREE CASES OF INFANTILE KALA AZAR.

BY MAJOR R. E. U. NEWMAN.

Royal Army Medical Corps.

In view of the differences of opinion which exist concerning the source of infection of infantile kala azar, a brief note on three cases of the disease which have occurred recently in Malta may be of interest.

Case 1.—H. C. A boy aged 18 months. An only child. Born in Egypt; father is English, mother is a Maltese. The child was brought from Egypt to Malta when about 6 months old. This child first came under notice early in May, 1920. The anæmia and enlarged spleen and liver at once suggested infantile kala azar, and *L. infantum* was found in large numbers by liver puncture.

Treatment by intravenous injection of tartar emetic was carried out, but the child died on March 21, 1921. In this case no clue to the possible source of infection could be discovered. No dogs were kept in the block of married quarters in which the family was living. The child had had several Maltese nurses but all of them appeared to belong to healthy families.

Case 2.—A girl aged 2 years and 1 month. Born in England of English parents. Brought to Malta when about 8 months old. The history of this child's illness dates from April, 1921, when she became fretful, and lost all appetite. In a few months she began to suffer from crops of boils on the head, and shortly afterwards the usual train of symptoms, diarrhoea, wasting, anæmia and enlargement of the abdomen appeared.

L. infantum was found by liver puncture on August 9, 1921. This child is still in hospital under treatment by hypodermic injections of antimonium oxide (Martindale). She has improved rapidly, and there is very marked diminution of the liver and splenic enlargement. A very marked improvement has also occurred in her general condition.

This child had played with a sick dog on several occasions about two months previous to becoming ill. This dog is stated to have been smuggled into Malta from Constantinople. It is said to have been ill and weak, and to have had a "swollen stomach." It was kept for about ten days, and then destroyed. No post-mortem examination of the carcase was possible after such a lapse of time. This child has had several Maltese nurses, but no possible source of infection can be traced through them.

There is another child, 8 months old and apparently quite healthy, in the same family.

Case 3.—A girl, aged 1 year and 7 months, the second child in a family of three. The parents are both English. The child was born in Malta. A young Maltese girl was employed to look after the child. The nurse was healthy, and there was no history of infantile kala azar in her family. The child became ill in June, 1921.

L. infantum was found by liver puncture on July 6. Treatment by intravenous injection of tartar emetic was at once begun. She bore the first injection (0.5 cubic centimetre of 1 per cent. solution) well, but the day following the second injection (one cubic centimetre of the same solution) she had a rigor, which was followed by a rise of temperature to 105° F. and she died twelve hours later, apparently owing to the toxic action of the antimonium tartaratum.

In this case also there was a definite history of a sick dog in the quarter next door. The dog was a small "terrier" mongrel. It is said to have been ill for some months previously. It was weak and wasted, and was constantly vomiting in the garden of the house where the child lived. It died about two months before the child came under notice and in this case also no post-mortem examination of the carcase was possible.

In two of these three cases there appears to be a definite history of association with a sick dog a few months previous to the child itself becoming ill.

This may be simply coincidence, but on the other hand a considerable proportion of the dogs of the Mediterranean Littoral are known to be infected with leishmaniasis. Views differ as to the possibility of transmission of leishmaniasis from dog to infant by means of the flea.

Wenyon, working in Malta some years ago, was unable to infect young dogs by means of fleas which had previously fed on dogs infected with leishmaniasis.

Nicolle, Laveran and Basile, however, consider that the leishmaniasis of infants and dogs is probably identical, and that infection is conveyed from one to the other by means of the flea.

It is unfortunate that no post-mortem examination of the carcasses of the dogs that died was possible in either of these two cases.

It is noticeable that each child first showed signs of illness at the beginning of the hot weather.

I am indebted to Major R. Storrs, R.A.M.C., for the clinical details of the above recorded cases.

Travel.

A SHORT WINTER SPORTS HOLIDAY IN THE AUSTRIAN TYROL.

BY MAJOR R. C. WILSON.

Royal Army Medical Corps.

ABOUT the middle of January, I received a communication from the powers that be that if I wanted three weeks' holiday I could take it in four days' time and that if I did not take it then the probability of having leave later was somewhat remote.

Where to go was the problem. England at that time of the year was impossible. Switzerland, for a family party was also out of the question, unless you are well endowed with worldly wealth. The only likely country left was Austria and we decided to go to Innsbruck. An interview with Thomas Cook & Son proved the impossibility of obtaining "sleepers" on the train as they are always booked up well in advance.

As we were a party of five we took 2nd class tickets which cost us 400 marks each for the single journey.

We left Cologne at 9.30 a.m. Belonging to the Army of Occupation we got a compartment reserved for military only, and possession being nine points of the law, had it all to ourselves until we reached Munich. There was an excellent restaurant car on the train and we had lunch, tea and dinner in comfort. All three meals for the five of us, plus drinks, came to about the equivalent of 15s.

Munich was reached about 11 p.m. and we had just time for a light supper of tea and cakes for the female party and a long pot of real Munich beer for the one male-representative, before the closing hour of midnight. We found the rooms we had engaged beforehand ready for us at the Hotel Roter Hahn.

The next day was spent in exploring this most interesting city. There is no space for me to describe what we saw, Baedeker can do it much better. If one knows where to go, living is cheap there. In our hotel we paid about 47 marks each for our rooms and that was the only item on the bill. Everything else we had was paid for in cash. Breakfast,

11 marks, lunch or dinner from 40 to 50 marks. In the more pretentious hotels it was different, 300 or 400 marks for a room was quite a common charge, and the other things in the same proportion. Our hotel was equal to a best second class hotel in England and the food much better.

We left next morning at 9.30 by the Rome express and arrived at Innsbruck about 2 p.m. At the frontier at Kuffstein we all had to bundle out bag and baggage, and go through the customs. Before leaving Cologne I tried to find out what was allowed to be brought into this country but was told such a number of conflicting tales that I was as ignorant in the end as at the beginning. One was the question of English money. I heard of one person that declared to having £20 on him and it was promptly sequestered; another said he had none at all, and so was on the point of being deported as an undesirable alien. I had £25 but said nothing about it. I told the Customs officer that I had a credit in the Anglo-Austrian Bank, which was true, as Holt and Co. arranged it for me. My suit-case was the first to be opened. It contained whisky, cigarettes, tobacco, etc., right on top, and only covered by a tennis shirt. On top of this shirt were two old packs of German cards which my wife put there at the last moment. These were seized upon with joy by the Customs officer and declared to be contraband. I saw an opening and took it. The train arrived nearly half-an-hour late and we were supposed to leave on time, and hundreds of people were clamouring to get their baggage franked. I said the cards were old friends and I did not want to part with them and offered to pay any customs duty he wished; we argued over these old cards for about ten minutes and then he said he would fetch the head "Major General." We started the argument all over again until about twenty people behind me announced the fact that the train was due to leave in a quarter-of-an-hour. This finished the matter—he took the cards, told me to close all my bags and marked them all with a beautiful cabalistic sign in pure white chalk. He was pleased and I more so. If he had only left the blessed old cards alone and lifted the tennis shirt he would have had a much more valuable find in the form of whisky, cigarettes, etc.

The train re-started more or less on time. The compartment we had to ourselves before was taken, but we found another. In a few minutes lunch was announced and we rushed to the restaurant car to get good seats, but found it almost empty. We wondered why but afterwards found out. The menu read good and visions of former visits to Italy re-appeared. The ministrone was half-cooked rice in hot water, the macaroni dish very poor, the meat so tough that it almost blunted the seemingly strong knife; a bad apple and a leathery fig ended about the worst meal I had ever eaten in a train. The bill for five people, plus a bad bottle of red wine and tips, came to 10,000 kronen. No wonder the car was half empty, after our experience of the good and ample food of the German trains.

Now it was like a transformation scene in the old-fashioned pantomime. Flat Germany disappeared—high snow-clad mountains appeared on either

side of the railway. The houses became more and more like Swiss chalets. Fat frauleins with the universal thick ankles gave place to more Italian-like types. The men ceased to wear double chins on the back of their necks. At Innsbruck things became more normal from our point of view, and English was more or less spoken and understood by most people. We spent two days at Innsbruck. The Hotel Kreid, where we stayed, was fairly comfortable, but, the town being in a valley surrounded by high mountains, was very cold and damp, you could not stir out without an overcoat and a muffler; also there was nothing to do after dinner except go to bed. Winter sports were a long way off and you had either to take a train or tram to get to the starting point.

We decided to leave and go to Igls, a village about three miles up the mountains. Usually a steam tram runs up there at regular intervals, but on account of the coal shortage it had ceased to function. We hired a sledge with two horses for the baggage and two passengers—the rest walked. This item cost 14,000 kronen, the most expensive item so far—only for a journey of three miles.

The hotel at Innsbruck was very cheap and everything included came to about 2s. 6d. a day each, that is at the rate of exchange we got then, of 40,000 to the pound, afterwards it dropped to 30,000.

The journey to Igls took about an hour as it was an ascent of nearly 1,000 feet, and we arrived in time for lunch. The change was wonderful. Instead of the dull fog of Innsbruck we found a brilliant sunshine, glistening white snow and wonderful snow-clad mountains on every side. The Igls sanatorium looked like an enchanted castle after the dull-looking hotels of Innsbruck. After a slight argument with the sledge-driver with regard to tips we partook of a most excellent lunch and afterwards started to dig ourselves in to our respective rooms. These, we found next day, were on the north side of the building, very cold and no chance of any ray of sunshine. However, next day, after a short interview with the management, we were able to change to the south side, where all day long we were bathed in sunshine. This is a point one often forgets: in winter the north side is impossible and if you don't ask for the south side you won't get it.

Before leaving Cologne I was warned to buy what I wanted in the way of winter sports' gear there but failed to do so as I thought that in the land of thousands of kronen things would be cheaper. It was quite the contrary. Boots, skis, lüges, cost about double the price in Germany, but much cheaper than England or Switzerland. Boots and skis about 32,000 kr. each, lüges from 8,000 to 10,000 kr. The two latter articles the shop promised to buy back at half price, which it did.

It was the first time that any of our party had been to a winter sports resort, so our first effort at ski-ing was the event of our lives. Luckily I did not know that wax and a cork polisher was a part of the equipment, so started off with unwaxed skis. It was as simple as falling off a log, went down slopes quite easily, climbed up again as easily as walking up

stairs, and all agreed there was nothing in it. Next morning an enemy initiated me into the mystery of waxing and polishing skis. I wore myself out on the job and the result was awful. The slopes I calmly slid down the day before I flew down at the rate of an express train—that is for the first twenty or thirty yards—then I seem to have collided with a goods train and what happened I don't know except that I arrived somewhere near the bottom in a tangled heap.

After a super-pelmanic effort I managed to find which was my left and right foot and how to restore them to their normal positions, a thing which seems impossible at first but gradually resolved itself. The next thing was to re-climb the slope, this same slope you walked up easily yesterday, now you fail miserably. After three or four steps you slip back at the rate of the aforesaid express train and apply the brake with your chin and nose.

However, it is an excellent sport and it keeps you nice and warm, at first one part from exercise and four parts from fright, later on in the reverse ratio. In a few days we all got expert enough to fly down ordinary slopes with only an occasional toss, and after a fortnight could undertake an expedition of several hours and enjoy it thoroughly.

To be an expert is quite a different matter; you have to practise hard, doing nothing but stemming and the various turns—telemacks, christianas, etc. How one got to hate these terms! At all meals you heard nothing else but “did you see me do that telemack this afternoon,” of course I replied, “yes, it was splendid,” but all the time I thought it was an ordinary fall. But one must be polite.

If you want to go on expeditions these things are absolutely necessary. Our party, I'm afraid, had to resort to the ungraceful way of avoiding “going over the top” of a nasty place by falling down and using all the portions of their anatomy available as a brake. It is very effective, but as I said before, not at all graceful.

There was about fifteen inches of snow during our stay and the ski-ing grounds were excellent, you could get on your skis at the hotel door and go for miles in any direction.

There were several excellent toboggan runs—two over two miles long. The best was from a place called Heiligewasser to Igls and was full of thrills—especially at the hair-pin bend. The experts flew down this run at express speed, but the writer, not being as young as he used to be, confesses to wearing out more of the heels of his nail-studded boots than he ought to have.

Races were held on this run frequently, and the local inhabitants, male and female, turned out in great force to compete for the prizes.

Everyone in this country from the extreme old to the very young has a lüge and never seems to stir one yard without one. A lüge is as much a part of their equipment as their boots. The sedate hotel manager gets on his outside the hotel door and slides down to Innsbruck to

order supplies; the maids of the hotel slide away on theirs when their work is over.

No matter what time of day or night you are wending your weary way up from the town you hear the yell "achtung," and someone flies past you. Why more of them don't break their necks going down this dangerous road beats me (only one did during our stay).

A word about our hotel. It was excellent. It is a sanatorium run by two Austrian doctors, Dr. O. Liermberger and Dr. J. Schuster, mainly for patients suffering from digestive troubles and blood diseases. Up to the present it has only been open during the summer months; this year it was opened as a winter sports hotel, and has been quite a success. It accommodates about eighty people, and its equipment is of the most modern type. The most pleasing part of it was the excellent bathing facilities. There was a big battery of bath-rooms at one end of the building, and a constant supply of boiling water day and night. Waiting for a bath never meant more than a few minutes. The most pleasing part of it was that there was no charge for baths, no matter how many you had.

There was also a modern installation of the usual fancy baths, douches, electric bath, etc., one finds in a first-class hydropathic establishment. These, of course, were not in use in the winter months.

The bedrooms were most comfortable, and all well heated, no extra charge. The food was excellent. Breakfast was served, as a rule, in our bedrooms.

Wines and other drinks were cheap, about one-sixth of the price in England. The pension rates are from 7s. to 9s. per day, no extras except room tax, which is 600 kr. per day per room, or about 7d. As a doctor I got special rates, 6s. a day, for each of my party. These prices are, of course, in excess of the other Austrian hotels, but the comfort of living in a well-heated hotel with good food and a comfortable lounge, where you can sit out in comfort after dinner and meet English people, is worth the extra money.

There was always something to do after dinner; dance to a gramophone, play bridge or join in an old-fashioned game of "Up Jenkins," etc. It is extraordinary how one unbends when one is a long way from home.

There is a hotel called Lannsersee about three-quarters of a mile away. This was taken in hand by a Colonel Unwin, who persuaded the manager to open it as a winter sports club for pre-war officers and some honorary members. The entrance fee is £1 1s. for the season, and the terms for pension £3 3s. a week.

There is a small lake alongside where skating can be indulged in when the snow can be persuaded from spoiling it. Here a real band provides music for dancing about three times a week. Another attraction is a bar, the only place in these parts where you can get a real drink, whisky and soda and cocktails, etc. For these luxuries prices are charged in English money. There are two professionals attached to the club, one for skiing and the other for skating. The former is a most charming Austrian

gentleman who, in pre-war days, made ski-ing a hobby, and now is clever enough to turn it to good account.

The hotel was almost full during our stay, there being about seventy English people there. Another consideration which appealed to the writer, and made the place more home-like, was the existence of a real bog a few hundred yards from the hotel where they cut real turf—the only one I have seen since I left a certain country.

It is a very pleasant country to live in, and the people, even those in the shops, are most polite. The people are very religious, and you cannot move half a mile in any direction without bumping into a shrine. Instead of the usual German salutation of "guten tag," the universal one is "Gruss Gott." The question of the exchange is utterly appalling, and if such a catastrophe happened in England, one shudders to think what would happen. Imagine having a sum of £2,000 before the war, and now it being only worth £1. That is what the value was when I was there. Still, the ordinary people one meets do not seem to mind; as paper money is turned out in unlimited quantities and wages and prices adjusted accordingly. The lowest unit is now 100 kronen except for the trams, which is sixty kronen. A copy of the *Daily Mail* costs over £40 at pre-war value.

As this district was an agricultural one, there were no signs of poverty, and the people seemed to be well fed, and all seemed happy and contented. What happens to the unfortunate families who are depending on a pre-war income or pensioners, etc., one dreaded to ask. I once did, but quickly changed the subject.

We left the place with regret and wended our weary way back to Cologne. It was weary, as there had been a strike on the German railways, which only ended two days before we left. The journey to Munich, instead of four hours, took eight, and during that time we travelled in every class of compartment except the guard's van. The usual weary business of getting through the Customs at Kuffstein. A word of warning. Do not rush to be first—there is an excellent restaurant where you can get coffee with real cream on top. Once you pass the barrier you cannot get back to the restaurant, and there is no restaurant on the German side. There is no need to hurry, as the train waits for the registered luggage to be passed, and that is always last. Luckily we brought a supply of food with us, otherwise we would have been in a bad way.

We arrived at Munich at 11.30 p.m., and found our rooms ready for us at the Roter Hahn.

Left next morning at 8 a.m. and arrived at Cologne at 9.30 p.m.

It was a very pleasant holiday, and for a family that cannot afford the expensive luxuries of a Swiss winter resort I can strongly recommend it.

The total expenses for a party of five—one male and four females—was a little over £45, everything included with second-class railway tickets. It is more comfortable to take sleepers and travel by night, and it saves hotel bills at Munich; but we could not give Cooks sufficient warning, and the strike upset things on the return journey.

Sport.

WITH A FISH SPEAR ON THE REEFS.

By ANDREW BALFOUR, C.B., C.M.G., M.D.

ALL day long the great waves had burst upon the reefs in snowy splendour. The surges, smooth, vast and heaving, symbols of immensity and power, had rolled shorewards till their bases felt the barrier reef, the long line of sunken coral guarding the still lagoon. And then, from being mere mounds of swift-moving water masses, they had taken shape, first as rollers with convex summits and the sun gleam in their concavities, and then as breakers, huge liquid walls, blue as the tropic sky, irresistible as fate. Each in its turn reared itself till the horizon was hidden, curved magnificently as it rushed towards dissolution, a plume of spray flying from its foaming crest, lines of vivid white streaking its great smooth back, its incurved belly suddenly transparent as its bulk thinned, as its pace quickened, and then down it crashed, down in a flurry of spume and froth, slobbering, swirling and sucking till overwhelmed by the next of the charging company sweeping shorewards from the south.

All day long the thunder of the surf had been borne to the island by the steady salt breeze, a sea music wild and sad, and lonely as the long-tailed phaeton bird flying high and solitary on its way to the cliff ledges.

Now night had fallen, coming swiftly as it does in these southern latitudes, but still the song of the sea rose out of the darkness, as the mighty swell sweeping northwards from the antarctic broke tirelessly, monotonously, endlessly on the guardian reef. It promised to be dark, which was all to the good, but there was still more than a breath of wind, sufficient anyhow to ruffle the surface and to make the sport more difficult. At least so we were assured by the Lascar, and who should know better than that semi-amphibious expert? He was one of the lighthouse staff, and lived aloft on the summit of the cliff where the squat white tower was already flashing its warning far out to sea. Having descended the long grass slope on the landward side, a slope reminiscent of the South Downs, and on which sheep and donkeys pastured, he was now waiting on the sandy foreshore with his little band of helpers.

Like Simon Peter of old, we were going a-fishing, but in a manner not practised, so far as can be told, by that impetuous apostle, though it is probable that it would have been greatly to his taste for, as we know, he was a man of action, and activity is very needful if one is to be successful with the fish spear on the reefs.

We had already stripped for the fray, and were now arrayed in bathing dresses with woollies and jackets above them, and what the old Highland-man called "proof-waters" over all. Shoes with rope or rubber soles, and short socks to guard the ankles completed our costumes, and the Lascar distributed the fish spears, each with two barbed prongs, nasty looking weapons and rusty with immersion in the brine.

The Lascar was tall and bearded. On his head was an old fez, his lean nether limbs were shrouded in thin cotton unmentionables, and his feet were cased in rope yarn wound round and round them to save his skin from the cutting coral. His myrmidons were similarly protected, and carried torches made of sacking wrapped about stout sticks, while two of them bore tins of fuel in the shape of petrol.

One by one we boarded the boat by the gang plank and, shoving off, were afloat upon the shallow lagoon. Poling slowly across it in the darkness we could yet make out the mass of the island rising behind us. Where the breeze sighed through the filaos on the level all was black and indistinct, but the dim outline of the cliff showed against the sky, crowned by the flashing light which came and went as it did years ago when Chinese Gordon, recking nothing of Khartoum and his fate, underwent upon Flat Island a period of quarantine, and beguiled his leisure by making of it a plan.

But we have no longer eyes for the main island for there in front of us is the islet of Gabriel from which the reefs stretch out and, as a sputter of rain drives down upon our bare heads, the keel grates softly upon a sandy beach. Discarding the mackintoshes we wade ashore, the water for a moment striking chill to the skin, colder than the rain drops which a moment before were pattering on our pates but which now happily ceased to pit the sea surface. Stand awhile and listen! Out yonder in the darkness, at no great distance, the sea is roaring on the reef. One can distinguish the crash of the comber and the slither and back-draw of the broken surge. What a fate to be cast upon that sunken wall of coral in time of storm and in the darkness! It is fathoms deep out there where the giant octopus spreads its tentacles and the great white shark pursues its quest. Dimly one can see the line of foam, and then all at once the night changes for the Lascar lights the torches. The sacking, drenched with petrol, flares to the match and in a moment all is bright around us while beyond is the outer darkness, a darkness almost to be felt. For a moment only; and then with eyes accustomed to the glare and the surrounding gloom we cross a sandy spit and step into shallow water.

Before embarking on this adventure we in our ignorance held the idea that it was a case of scrambling about amongst rocks and peering into pools, now in the briny, now out of it, something like a schoolboy's hunt for crabs on the coast at home. Instead, we found ourselves half-way up to the knees upon a plateau of coral across which the tide was streaming, running like a river, yet minus the latter's force. The sea surface was a

mass of ripples which to some extent concealed the view but as the Lascar held his torch aloft we gazed upon a fairyland, a strange sub-aqueous country, pitted and painted, a curious irregular gleaming track somehow suggesting pictures of the extinct craters of volcanoes in the moon. The prevailing colour was a bright creamy white but here and there were pink patches and in places where the water deepened into pools a wondrous glow gleamed in the torchlight. Mottled shells, strange weeds streaming on the tide, fantastic clumps of branched coral met our gaze as we viewed these submarine gardens.

There was, however, scant time to admire this strange world for almost immediately we caught sight of fish. Dazzled by the glare some of the smaller finny tribe were lying just below the surface, tiny creatures like sprats and little plump fellows the colour of ruddy gold-fish. The former we find we can take with the hand. The latter easily avoid the spear and dart away beyond the circle of light or take refuge beneath some stone or ledge. Suddenly we see a long ribbon-like, greenish-blue shape motionless and within range. It is a gar-fish, a harlequin of the deep, and we dart the spear at it. Away it flashes and after it speeds the Lascar at an amazing pace considering the nature of the reefs. Holding the torch aloft he actually gains upon his prey, then with a sudden lunge drives home the grains and raises the gar-fish pierced and dripping. The rapid rush has caused the torch to flare, the flames to spread unduly. He lowers and dashes sea water upon it till, hissing and spluttering, the flame is under control. Then the hapless quarry is shaken off into a sack and the hunt resumed. We have scarcely recommenced stabbing at small fish without avail when the Lascar, discarding his spear, stoops suddenly and next moment drags aloft in triumph a huge "cray-fish" which we had not so much as seen but which his keen eye had detected black and hunched upon the coral. Its legs wave abroad, its antennæ quiver and it protests with a strange kind of grunting squeak speedily smothered by the sack. For a moment we straighten ourselves and look about us. Afar off in the inky darkness is the glow of another torch marking where the rest of our party are busy with the sport and away beyond one can see a line of snowy-white whence comes the dull roar of the breakers. It is strange to stand in the torchlight and gaze into the outer blackness. Doubtless the Lascar knows where we are and we are thankful for the thought, as, without him, we have the feeling that we would indeed be lost.

To it again, however! Something dark goes scurrying off along the bottom and after it speeds the amazing Lascar, while, again like Simon Peter, we follow afar off, but doing our best to keep up with the chase. The Lascar lifts his legs high, splashing vigorously, seemingly as sure-footed as a chamois. His torch is raised, he has handed his spear to the boy with the petrol tin and scurrying, slipping and chuckling behind him we stagger in his wake, our eyes glued on the dark shape which glides along, twisting and turning, evidently in mortal fear, clearly in a mortal

hurry. Once, twice the Lascar makes a pounce in vain, but the third time's lucky, and, stooping again like a hawk upon its prey, he holds aloft another squeaking "cray fish" under whose flexed tail we see rows of spawn shining orange in the torch glare. Spawn or no spawn into the sack it goes, while the Lascar grimaces and shakes his fingers dolorously, for he has pricked himself upon the crustacean's spiny carapace.

And now the fun grows fast and furious and after a few ineffectual prods we begin to tumble to the game, to gauge the refraction, to take toll of the fish. We are fairly amongst them and there seem to be no end of species. The Lascar beckons and points downwards. For a moment we see nothing and then discern a ruddy shape lying still beside a stone. We steady the spear and lunge into it and through it, there can be no doubt of that, and up comes a plump red mullet well and truly pierced.

A moment later another dart yields a *vieille*, or spotted rock cod. It is the *vieille gris* we have taken, the Sarranus with dark brown blotches on it, but later a lucky thrust secures a fine vermilion-red *vieille rouge*, a fat two-pounder, succulent and well-liking.

It is exciting work, this fish-spearing and we begin to shout and echo the hunting cries of the Lascar who is here, there and everywhere, pouncing upon "cray fish," driving his harpoon right and left and rarely missing his quarry. Now it is a curious pig-snouted fish, flattened from side to side and with black bars running across it, again it is a silvery mullet with a strange sucker-like upper lip adapted for grubbing in the sand.

At every step almost we disturb some bewildered inhabitant of the reef. Crabs, weirdly spotted, go scuttling along in wild alarm; we come upon star-fish spreadeagled on the coral, and bambaras abound, great fat repulsive sea slugs, like black sausages; at one time hunted by the Chinese of Mauritius and still esteemed by these lovers of strange luxuries, though now they no longer export cured bambaras as they used to do.

Sea urchins lie tucked away in crannies and we avoid their spines though, protected as we are, there is little danger either from them or the deadly laff, that hideous warty fish with poisoned spines which haunts the reefs and is justly dreaded by the bare-footed fisherman.

"By jove, there's a queer fish!" We lunge, strike something firm and wriggling, crush it into the powdering coral, feel it squirming and writhing, and, ere the water clears, hoist up a strange and struggling creature with a long horn projecting from its forehead as it were, horizontally not vertically. The prevailing hue of this "rhinoceros" fish is a dull olive green, but there are yellow markings on it, and near its tail on either side are a pair of brilliant blue caudal spines placed one behind the other, their business ends directed backwards. In shape they resemble the stout and broad-based prickles of a rose-bush, and must prove effective weapons capable of inflicting painful wounds. Talking of wounds it is curious how expressionless is the eye of a fish. There is no evidence of suffering in it

even when the captive has been badly mauled by the grains. One is fain to hope that the fish do not feel much. Yet they are intelligent creatures as anyone must admit who has studied their habits, and one would expect from their nervous organization a certain delicacy. Undoubtedly, however, they are not sentient in the same way as a bird or mammal for which we are thankful even while we hunt them.

There are no true cray-fish on the reef but the bag of lobsters so-called, grows steadily bigger for the Lascar misses very few of them, though now and then one dodges him over rough country. For the most part we have not been submerged much deeper than the ankles, and it is remarkable how large a fish the shallow water will shelter, but now there is a talk of *cateaux*, the famous blue fish which, at a certain season of the year, the Lascar spears actually in the waves as the latter gallop shorewards. It is said he can whip one of these vivid parrot fish out of the body of a comber even as it darts along above the level of his head. To-night, however, there is no need for such gymnastics. We are after two, three and four pounders and to get at them cross a sand-spit and sally out upon another reef where the water is deeper and pools, some of a considerable depth, abound. At any moment now we may be up to the waist so it is well to "ca' canny." It is easier for the novice to spear the smaller fry in the pools for they take shelter at the bottom and can be detected hiding snugly below a ledge. Some, however, blend so marvellously with their surroundings that, were the Lascar not with us, we could never have detected them. Long practice combined with keen sight has given him a vision which an owl might envy, and as he wades along he points here and there, the while he picks up unconsidered trifles which the torchlight has held for a moment fascinated and inert.

But suddenly he gives a shout and from a pool there rushes out a big fat shape of vivid blue. The glare has only been sufficient to scare it, for it is on the outer margin of the magic circle and is off for safety into the gloom. Vain hope! On its trail springs the Lascar. How he keeps his footing is a marvel, but fast as the fish travels, he travels faster, and in a few seconds the chase is over. Out flies the spear and next moment it is hove up with a really big fish on the end of it, a lumpy, surprised-looking, bright blue parrot fish, its flesh showing pink through the gash in its painted flank. They are fair eating these *cateaux* if not kept over long, but they are a soft fish and not comparable with the rock cod, the red mullet, the noble, deep sea *capitaine*, or the beautiful *cordonnier*, which is best taken with the net.

Very soon we are "spotting" *cateaux* on our own account for one cannot well miss seeing a cærulean mass the size of a small cod even if it lies hunched up against a lump of coral, blinded and motionless.

It is easy enough to spear the parrot-fish. One can advance the spear under water till the prongs are an inch or two from the prey and then a single lunge drives the points home behind the gills. There is a startled

flurry and we heave up the *cateau*, which looks more like a freak than a fish, what with its pouting mouth, its staring eyes and its amazing colour. There are green and red *cateaux* but here upon the reef we see only the blue variety. It is plentiful and soon we have a dozen and more.

When crossing from one reef to the other we had emptied our sack, for there is a limit to the fish which can be carried and so there is plenty of room for *cateaux* and cray-fish and anything else we may happen to come across.

But the torch is near an end and we feel we have had enough of slaughter. It seems the other party have come to the same conclusion, for, as we quit the reef, we see their torch not far away and hear them splashing towards the sand-pit.

Soon we foregather and find they have been equally lucky, for, though they lacked the Lascar they were not without experience of the sport, and in any case appear to have secured even a greater variety than had fallen to our share. They had encountered an eel, a formidable brute with nasty teeth and the proverbial tenacity of its kind, but after putting up a fight he had yielded up the ghost and lay mingled with the scaled and the scaleless.

Tired, but cheerful, we bundle into the boat and cross the lagoon. On the beach of Flat Island—a curious misnomer—we empty out our spoils, some eighty pounds of fish, and light a torch and gaze at the trophies. Already the glory is departing from them; the colours are fading, the eyes are dull, the tails are drooping. Only the “cray-fish” remain unchanged. They are still alive, clashing feebly as they move, perhaps wondering what they are doing in this gallery, let us hope unconscious of their fate and unaware of how they will change from speckled bluish-black to speckled red.

The torch is quenched, the Lascar gathers the spears, the fish are sacked again and we plough through the shelly sand to where the night breeze is still rustling in the resinous filao, while behind us out of the darkness from the fairyland of the sea rises the song of the breakers tumbling eternally upon the reefs.

Current Literature.

Incidence of Infection with Pfeiffer's Bacillus before, during and after the 1918 Epidemic. By J. W. McLeod, A. G. Ritchie, and C. A. Dottridge, *Quarterly Journal of Medicine*, July, 1921.—The observations of the epidemiologists go to show that there is something like a ten-year cycle in epidemic influenza, a heavy incidence having been noted in 1869, 1879, 1890, and 1898, but not apparently between that period and the recent epidemic. If Pfeiffer's bacillus is the cause of influenza, it is to be expected that the investigations recorded with regard to its incidence should show a gradual diminution of infections due to that bacillus in the years following an epidemic and a gradual increase in infections due to it in the years immediately preceding an epidemic. The authors have examined carefully such findings as have been recorded between 1900 and the first year of the war and find that the data are rather scanty, but so far as they go, they suggest the following ideas:—

(1) In Europe the incidence of Pfeiffer's infections was low throughout the period, although there were probably some localized epidemics like that recorded by Scheller, and nearly corresponding to the period of the suggested ten-year cycle.

(2) That in America, although no epidemic with a high incidence of Pfeiffer infections is recorded, yet there appears to be in certain areas at all events a rather high endemic rate of infections with Pfeiffer's bacillus in chronic bronchitis.

(3) There seems little doubt that amongst children a high percentage of infections with hæmoglobinophilic bacteria, whether *Bacillus pfeiffer* or not, is the rule in all conditions associated with catarrh of the respiratory tract.

(4) That taking into account the rather scanty observations available on normal individuals, and those on cases of pulmonary tuberculosis, one can probably fix the percentage of carriers of Pfeiffer's bacillus in a population which has not recently been visited by an influenza epidemic as between nil and 10 per cent.

These conclusions were drawn from Table I. In Table II the authors have summarized all the records they could find of infections with *B. pfeiffer* between the first week of the war and the outbreak of the 1918 epidemic. A comparison of the two tables brings out certain contrasts.

(1) A much larger number of localized epidemics of influenza, bronchitis, or atypical pneumonia associated with *B. pfeiffer* infection was recorded between 1915 and 1918 than in the preceeding years.

(2) The figures for incidence of *B. pfeiffer* infection in connexion with influenza were higher in these epidemics than in any recorded in the previous ten years except that reported by Scheller at Koningsberg in 1907.

(3) That the contrast between the figures before and after 1915 is not found in the American as in the European publications.

The paper now goes on to deal with the epidemic and summarizes as follows: In so far as the records are to be trusted, they lead to the conclusion that Pfeiffer infections after remaining infrequent for many years were noticed in numerous localized epidemics from 1915 onwards till during the epidemic of 1918 the great majority of the patients attacked, and also a very considerable percentage of healthy contacts, were found to be infected with Pfeiffer's bacillus; but that with the disappearance of the epidemic the incidence of Pfeiffer's bacillus in the respiratory tract of healthy individuals has notably diminished.

The authors now proceed to their own observations and to see how they fit in with the above ideas. They have no record of incidence of Pfeiffer infections amongst healthy individuals prior to the 1918 epidemic. In February, 1917, a

case was seen which definitely supported the impression derived from the literature that there were many localized influenzal epidemics in that year.

During the summer epidemic of 1918 the authors found *B. Pfeiffer* in sixty-six per cent of cases, and at the same time got 0.33 per cent of carriers. The numbers examined in both instances were small.

During the autumn epidemic no observations were possible, but in March 1919, of fifteen sputa examined twelve, or eighty per cent, were found positive. During this third wave a number of post-mortem examinations on patients who died after seven to twelve days' illness showed suppurative pneumococcal, streptococcal and staphylococcal lesions predominant, although here and there an influenzal broncho-pneumonia with *B. Pfeiffer* predominant, was observed. Observation for carriers in March, 1920, showed eight per cent positive.

The final summary is then made in the following words: We appear to be dealing with a bacillus relatively rare in the periods remote from epidemics, finding opportunity of exalting its virulence by frequent passage in numerous localized epidemics in the years immediately preceding a major epidemic, and then finally reaching that high degree of infectivity which enables it to affect a very large proportion of the community. It then rapidly increases its virulence, till at the height of the epidemic it becomes capable of producing a fulminating illness with a characteristic lesion rarely seen at other times.

Lastly, the authors point out that it is very essential that the gaps in our information should now be made good in several respects.

(1) Careful and systematic investigation should be made in order to correlate clinical symptoms and bacteriological findings in acute catarrhs of the upper respiratory tract.

(2) The percentage of *B. Pfeiffer* amongst the healthy population should be determined yearly in various places.

(3) More data should be obtained as to the percentage of Pfeiffer infections in various diseases of the respiratory tract.

The Transmission of the Pneumonia-producing Group of Organisms.

By Lieutenant-Colonel J. G. Cumming, Medical Corps U.S.A., and Captain C. B. Spruit, Medical Corps U.S.A. *The Military Surgeon*, U.S.A.—The authors commence by defining the pneumonia group of organisms and by drawing comparisons between pneumonia as it occurs among the civil and the military population as observed by them.

The pneumonia group of organisms only includes those which have been isolated from the blood stream of pneumonia cases; these are the type pneumococci, the hæmolytic streptococci and the *Streptococcus viridans*.

In civil practice the type pneumococci are the common cause of pneumonia. This is not the case in the Army; when lobar pneumonia does occur among the troops it is most frequently complicated by secondary invaders which prolong the illness and are the immediate cause of death. The virus infections—measles, scarlet fever and influenza—prepare the soil for an invasion of lung tissue by secondary invaders which are harboured in the upper respiratory passages.

Having in mind the occasional occurrence of hæmolytic streptococci complications in cases of scarlet fever in civil hospitals, and recognizing that measles, the disease which was being dealt with at the time, also belonged to the group of virus infections, it was decided to make a search for these organisms. An investigation of throat swabs of measles patients upon entrance into hospital, of sputum, empyema pus, and particularly of the blood of pneumonia cases, left no doubt but that the hæmolytic streptococci were responsible chiefly for the heavy toll in post-measles pneumonia deaths in the Army.

This investigation now raised the question as to why and how the streptococcus should be so prevalent in the throats of men under military conditions.

The authors further observed that in the influenza epidemic of 1918 epidemiological investigation gave practical demonstration of the importance of using only boiling water for washing up mess utensils. Among 66,000 troops it was shown that the use of tableware, etc., which was washed in boiling water, had a marked influence in reducing the incidence of influenza and pneumonia, whereas the washing in warm water resulted in five times more influenza cases and pneumonia deaths—this, too, amongst troops who were under the same conditions of overcrowding, fatigue, age susceptibility, etc.

Following these preliminary remarks, the paper now deals with a detailed description of laboratory studies which include the isolation and identification of organisms of sputum-borne infections from eating-utensils wash water, from hands, inanimate objects, and from air and floor dust.

The deductions drawn from these studies are :—

(1) The streptococcus carrier rate is many times greater among average troops than among average civilians. The pneumonia and other complications of the virus infections are greater in the Army than in the civil populations, and among troops this is due to the higher carrier rate of the group of pneumonia-producing organisms.

(2) This higher carrier rate was not due to overcrowding in barracks but to insanitary utensil washing, incident to crowd messing.

(3) The danger incident to crowd messing can be eliminated by the use of boiling water for the washing of eating utensils.

(4) Environment is a subsidiary cause of disease production; blocking the avenues of transmission, thereby preventing infection in susceptibles as well as immunes, is the crux of control.

(5) The institution of control methods applicable to the prevention of pneumonia will automatically control the virus infections.

(6) In order of importance the eating utensil appears to be foremost as a distributing agent of the sputum-borne disease, the hands ranking second, inanimate objects third, and the air fourth.

(7) Laboratory researches as well as epidemiological investigations in the Army and public institutions, indicate that the greatest possibility of sputum-borne transmission occurs in the mess—contaminated hands and utensils in the Army, and partially washed eating utensils in public institutions as well as in public eating places and the home. Therefore, the asepsis of eating utensils in the Army, in public eating places, and in the home, appears to be of the greatest importance in sputum-borne disease prevention.

(8) In the prevention of sputum-borne epidemics it is indicated on the basis of "the theory of case and source elimination" that the universal application of eating utensil pasteurization, thereby blocking the major avenue of distribution, will accomplish the desired end.

Reviews.

THE PREVENTION OF MALARIA IN THE FEDERATED MALAY STATES. By Malcolm Watson, M.D., C.M., D.P.H., with contributions by Drs. P. S. Hunter, Singapore, and A. R. Wellington, F.M.S. Pp. 369, with figures, plans and charts.

THIS is the second edition of Dr. Watson's standard work and will be received with interest and read with profit by all concerned in anti-malarial work; true believers will have their faith reinforced, and doubters, one hopes, will be confounded.

The details of some of the difficulties encountered by Dr. Watson may be mainly of local interest, but the lessons to be drawn are of wide application. That draining marshes and clearing jungle would intensify malaria might some time have seemed a paradox, but now the time gives it proof. In the coastal plain of Malay, malaria is due to *Anopheles umbrosus* which breeds in pools in undrained jungle, and cannot breed in open earth drains with a current of water and free from weeds. Clearing the jungle and draining the pools eliminates *A. umbrosus* and with it malaria. In the coastal hills when the ravines are under jungle, *A. umbrosus* is also responsible for malaria. When the jungle is cleared and the pools replaced by well cut drains *A. umbrosus* disappears but *A. maculatus* takes its place, and the better drained the ravines the greater the number of *A. maculatus*, so that the last malarial state is worse than the first. *A. maculatus* can be abolished from ravines by putting its breeding places underground in sub-soil pipes, or by systematic oiling operations.

The inland hills are non-malarial when under jungle, because *A. umbrosus* does not exist there, but when the ravines are opened up *A. maculatus* appears and the district becomes intensely malarious. The most economical anti-malaria measure here is to allow the ravines to revert to jungle. Dr. Watson also tells us that rice fields on the coastal plain are practically free from malaria; here the *Anopheles* are *rossi*, *kochi*, *sinensis*, *barbirostris* "and maybe *fuliginosus*." Whereas rice fields in narrow valleys are usually malarious; here the same *Anopheles* are found, with the addition of *A. aconitus*, which has been proved to be a natural carrier. There is hope that the water in the valley rice fields can be polluted to resemble that found in the rice fields of the plain, with a consequent freedom from malaria.

Dr. Watson's work, his difficulties, temporary set-backs, and final success, warn us against assuming that anti-malaria measures found satisfactory in one place will necessarily be effective in another, and that careful studies of the local species of *Anopheles*, their infectivity, and breeding habits, are an essential part of any successful war against the mosquito. As one of Dr. Watson's contributors pertinently remarks, "the extermination of any animal from an area where it is prevalent is rarely possible unless the exterminators possess some knowledge of the animal and its habits; the chances of success are infinitesimal when the hunter cannot recognize the animal when he sees it." We are all familiar with the "practical sanitarian" who "doesn't bother about varieties of mosquitoes." Perhaps, to adapt a phrase of Colonel Alcock's, the experience of Dr. Watson and his associates will appeal to even the most unpractical of "practical sanitarians."

THE ÆTIOLOGY AND PATHOLOGY OF TYPHUS: BEING THE MAIN REPORT OF THE TYPHUS RESEARCH COMMISSION OF THE LEAGUE OF RED CROSS SOCIETIES TO POLAND. By S. Burt Wolbach, John L. Todd and Francis W. Palfrey. Pp. 222, with xxxiv plates (89 figures), and other illustrations.

THIS Report embodies the results of observations based on 181 cases of clinically well-established typhus, and in the words of the Commission, their

findings "both in regard to the ætiology and pathology of typhus prove in the main to be confirmatory of the work of many widely separated workers. We have added somewhat to the knowledge of the pathology and extended considerably the knowledge of the ætiological agent." The Report includes chapters on Technique, Clinical Observations, the "Weil-Felix" Reaction, *Rickettsia*, Typhus in Guinea-pigs, etc., and the pathology and pathological histology of typhus in man, are treated in great detail and excellently illustrated. The writers are satisfied that *Rickettsia prowazeki* is the causal agent of typhus fever, and they consider that Fraenkel's perivascular "nodules" are due to the proliferative reaction of the tissues to local invasion by these organisms; but such nodules they believe to be secondary to, or their position determined by, primary lesions of the intima which they found a more constant diagnostic test than the occurrence of nodules. They claim to have demonstrated the parasites in lesions in the blood-vessels of the skin, brain, kidneys, muscles and testes in the human subject, and plates are reproduced in support of this view.

As originally shown by da Rocha Lima, *R. prowazeki* is intracellular in *Pediculus humanus*; as regards extracellular *rickettsia* in human lice, the Commission incline to believe in the identity of *R. quintana* and *R. pediculi*. The acceptance of this view necessitates either the abandonment of *rickettsia* as the cause of trench fever, or the assumption that the inhabitants of Central Europe are tolerant of *R. pediculi* and consequently immune to trench fever.

The agglutination reaction to organisms of the enterica group was tested in ninety of the typhus cases, with interesting results. The serum of 15 agglutinated *Bacillus typhosus* in maximum dilutions from $\frac{1}{100}$ to $\frac{1}{1000}$; while 27 gave a positive reaction in maximum dilutions of 1 in 52 to 1 in 100; 48 gave no agglutination of *B. typhosus*. These reactions are attributed to the peculiar propensity of typhus fever to show non-specific agglutinations. In this connexion it may be remembered that W. J. Wilson (the real discoverer of the so-called "Weil-Felix" reaction, noted the presence in typhus cases of agglutinins for coliform organisms as well as for *B. proteus*. The Report gives most interesting tabulations of parallel agglutination results for *B. typhosus*, *B. paratyphosus* A and B, and for two strains of *B. proteus* X 19; the writers found the reaction of *B. proteus* "valuable as a supplement to clinical observations in the diagnosis of typhus."

In the process of lousing typhus patients, a mixture of equal parts of kerosene and "lightwood oil" was found very efficacious for application to the body after shaving or clipping the body hair. The head was not washed as this prevented the penetration of the oil into thick dandruff and allowed some lice to survive.

Enough has been said to demonstrate the scope of this work, but an adequate idea of its extent and completeness can be obtained only by studying the original, which no one interested should fail to do.

The report is in itself an evidence of exact and laborious work, and it seems a pity that the compilers should have admitted the redundant and unscholarly hybrid "delouse." In at least one instance they employ the classical English verb, "louse," which has come down to us from Anglo-Saxon times, and still exists as a living word. Surely this would have sufficed throughout.

The Commission dedicate their Report to the memory of seven investigators who died of typhus contracted in their researches on this disease, and whose names are set out on the dedicatory page. There is now, alas! another name to be added to the melancholy list, for A. Bacot, a member of this same Commission, has in like manner—

— paid the vile forfeit of untimely death."

Correspondence.

TICK FEVER IN EAST PERSIA.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

DEAR SIR,—In the June and September numbers of the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, 1920, two investigations into outbreaks of tick fever in East Persia were reported, and having recently received requests for further information in regard to this disease I shall be glad if you could find room for the following:—

In the above accounts for the purposes of comparison greater stress was laid on the types of fever as portrayed by the temperature charts and the disease and its symptoms were unfortunately inadequately described. This has apparently led to the erroneous idea that the disease is a mild one (Manson-Bahr, recent edition).

The experience of the permanent Persian officials attached to the British consulate in Mashed was that the disease was usually fatal to Europeans and Indians prior to the introduction of salvarsan products by us, and that it usually took on an acute hæmorrhagic form with cerebral symptoms. In the rare cases of recovery the patient lapsed into a condition of asthenia, irregular fever, wasting and cachexia with intermittent hæmorrhage which was compared to tuberculosis, and this necessitated their leaving the country.

Many of the cases seen by us, especially the cases with hæmorrhages, suffered from restless delirium with cerebral symptoms, and if it had not been for the prompt injection of salvarsan these cases would have ultimately died. During the height of the initial attack of fever the constitutional disturbance is not uniformly so severe as in the initial paroxysm of Indian relapsing fever, but it is a more serious disease because the succeeding two or three paroxysms become more serious, whereas, in the Indian disease, the succeeding paroxysms are as a rule, lighter than the initial one, and in addition, the condition of chronic infection does not, as far as we know, supervene.

Chart No. 3 in the June number of the Journal, 1920, illustrates a case of chronic tick fever. In this instance after repeated blood examinations a single spirochæte was seen in a blood film more than thirty-seven days after the onset of the disease.

The absence of fatalities in our time was not due to the mildness of the disease but resulted from its early recognition and the immediate exhibition of salvarsan products.

It is true that the cases reported in the second outbreak did not become cured after a single injection of salvarsan given during the height of a paroxysm, as the cases in the first outbreak did, but still they responded to treatment; a marked improvement took place after each injection and no case became wasted and cachectic, like the patients from whom the drug had been withheld.

In regard to the carrier of the disease, the intended further investigation into this matter mentioned in the September number of the Journal, 1920, did not

take place owing to the onset of serious illness, during which period all ticks collected for examination died. However, I am strongly of the opinion that although the *Argus persicus* may occasionally serve, the real culprit is the *Ornithodoros lahorensis*.

My reasons for this belief are : in the early day of the Lines of Communication East Persia, prior to the building of hutments all troops were billeted in Persian houses. The poorer Persian usually lived in close contact with his livestock, i.e., chickens, and the *A. persicus* was frequently present. In my own billet they could be usually seen on the walls and I have on occasions removed them from my bedding. This tick apparently was not strongly attracted to us and I heard of no case in which our men had been bitten and certainly no outbreaks of tick fever occurred. In these houses in my experience no ornithodoros ticks were seen.

In the serais which housed both man and beast both the *O. lahorensis* and *A. persicus* were prevalent. The ornithodoros as a rule was more numerous in the ratio of 4 to 1.

After the building of hutments the troops came into contact with ticks on two occasions only and both of these exposures to infection took place in serais from which the *O. lahorensis* and *A. persicus* were recovered and an outbreak of tick fever resulted.

During the investigation of the second outbreak at Sharijalak, where our men had been the sole occupants of rooms in a serai for two weeks or more, it was noted that all ornithodoros ticks captured were seen to have had a recent feed of blood, whereas all *A. persicus* ticks were seen to be pale and empty.

In the bedding of one Sepoy who bore bleeding bite lesions on his neck a gorged *O. lahorensis* tick was alone found, and this man developed tick fever eight days later.

In the first outbreak all the men were bitten on one occasion only. They all developed fever on the same day and the disease did not show any variation either in character or intensity whether the men had been bitten by two or fifteen ticks. The temperature charts all showed an initial rather irregular type of fever of one to eight days' duration, followed at variable intervals by short spiky relapses. All these cases, as a rule, were cured by a single injection of salvarsan administered during the height of a paroxysm.

In the second outbreak men were exposed to infection for many days and were bitten on successive nights. The symptoms and general characters of the disease remained unaltered, but many of the cases developed a more continuous type of irregular intermittent fever, of upwards of sixteen days' duration, which was usually followed by short spiky relapses as observed in the first outbreak (*vide* Chart IX, JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, September, 1920). These cases were only cured after several injections of salvarsan; epistaxis occurred and spirochaetes were sometimes observed in blood films during apyrexial periods.

We know by experience in ordinary relapsing fever that the administration of salvarsan during an apyrexial period does not arrest a paroxysm and from the above it would appear that each brood of developing parasites maintained its own period of development, and the coalescence of these cycles gave rise to the more continuous irregular remittent type of fever and, in addition, each brood necessitated a dose of salvarsan to be operative against it during its spirochaetal

stage in the peripheral blood before a cure could be effected (*vide* Conclusions, September number of the Journal, 1920).

The last question that remains to be answered is as to the possibility of the occurrence of this disease in North India. I have it on good authority that a disease of the same nature and conveyed in a similar manner occurs along the trade routes in Afghanistan. The Afghans are merchandise carriers in East Persia, and the trade route from Peshawar via Herat to Meshed is a very old one. With the opening up of freer communications with Afghanistan the conveyance of infected ticks is possible, but the only place where endemic disease may be established is at the frontier where trading occurs and bales are opened up.

I trust that these remarks will elucidate a few points which were not clearly defined in the previous communication.

I am, etc.,

London, March, 1922.

C. H. H. HAROLD.

REPORT ON A CASE OF CONVULSIONS TREATED WITH LUMINAL.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—With reference to the published notes in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS for March, 1922, the best preparation of luminal to prescribe appears to be "Luminal Sodium," which is easily absorbed and dispensed, according to the instructions issued with this drug by the manufacturers.

Luminal itself is apt to set up digestive disturbance and is very insoluble in all media and is difficult therefore to dispense.

This treatment is equally efficacious in epilepsy of adults and is far superior to results obtained from the bromides of potassium, sodium, etc.

The dosage for adults and children is practically the same; one grain morning and evening is a good dose to begin treatment with; and if necessary this can be increased by half a grain at night.

Guernsey,

March 21, 1922.

I am, etc.,

G. T. RAWNSLEY, Colonel.

MALARIA IN PALESTINE.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—With the advent of Spring the question of malaria in tropical and sub-tropical countries becomes urgent. In Palestine, a country which is intensely malarial in places, and one in which there are many small stations, usually staffed by one or two medical officers, the ability of these officers to detect the early occurrence of mosquito breeding and the presence of anophelines becomes of paramount importance.

It has been noticed in the past that though in many cases officers have been through a tropical medicine course, their knowledge of this very important subject is scanty, and it is suggested that the value of the tropical medicine course would be greatly enhanced if more time were spent in the actual identification of mosquitoes and larvæ.

During the past two years several instances have occurred in which mosquito breeding and the prevalence of adult mosquitoes have been missed by the medical officers in out-stations with the most disastrous results. In each of these cases the insects were present in such enormous numbers that it is hard to understand how failure to identify occurred.

In two of these cases the medical officers concerned had, I am informed, been through a course in tropical medicine fairly recently.

With a view to avoiding such mishaps in future, medical officers in this command have been lectured upon the identification of mosquito-adults and larvæ, and "spotting" courses have been instituted, in addition to lectures on the ordinary measures for individual protection, malarial work in the field and so on.

A little guide for the identification of mosquitoes has been issued to each medical officer, together with particulars of the common malarial carriers of the country.

It is suggested that something of the sort, at any rate giving particulars of local carriers, might be worked out for each tropical command and issued to each medical officer stationed therein.

In conclusion, it may be thought that these few remarks are making reflections on the efficiency of the tropical medicine courses. This is far from my intention. The course I attended was far reaching and of the utmost value, but as a matter of practice medical officers do not seem to have picked up the knack of early detection of mosquito-breeding and the presence of adult mosquitoes, and this letter is a plea that more time may be spent on the identification of specimens both of adults and larvæ.

I am, &c.

N. Low, Major,

*Bir-Salem,
February 24, 1922.*

*Royal Army Medical Corps, Deputy Assistant
Director of Headquarters, Palestine.*

Note.—Para II Army Order 558 of 1920 directs that all junior officers must attend a course in Tropical Medicine at School of Hygiene, Blackpool (now at Aldershot). This course includes instruction in medical entomology; also systematic instruction in entomology is now a recognized part of the senior and junior officer's course at the Royal Army Medical College. This course includes identification of mosquitoes, both adults and larvæ.

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HÆMATOPHAGY AND HÆMETABOLY AS A NORMAL
FUNCTION OF VARIOUS TYPES OF TISSUE-CELL.—I.

By H. M. WOODCOCK, D.Sc.LOND.

*Fellow of University College, Head of the University Department of Protozoology.
(Lately Protozoologist to the Egyptian Expeditionary Force.)*

"Never refuse to see what you do not want to see, or which might go against your most cherished hypotheses, or against the views of authorities. These are just the clues to follow up, as is also, and emphatically so, the thing you have never seen or heard of before. The thing you cannot find a pigeon-hole for is the finger-point showing the way to discovery." (From a letter by the late Sir Patrick Manson; quoted by Dr. P. Manson-Bahr, in *Brit. Med. Journ.*, April 29, 1922, p. 702.)

INTRODUCTORY.

EVEN before my introduction to the study of hæmatophagy was published [10] I was becoming aware that my first glimpse into this untrodden field had been far from revealing to me its full extent; and what I have since ascertained leads me to think that my conception will have to be greatly amplified and expanded. Because I now consider that this function of the metabolism of blood elements *normally* is not confined to the macrophages, but is exercised by certain—probably, indeed, by many—types of tissue-cell, not for the purpose of assimilating and making use of the products of digestion for their own growth and multiplication, but in order to elaborate by the utilization of the formed blood-constituents (mainly the red corpuscles), various substances coming in the category of secretions or excretions, which are requisite for the welfare of the body as a whole. I propose to distinguish this metabolism of the blood-elements, whether it occurs intracellularly or extracellularly, by the term *hæmetaboly*,

restricting that of hæmatophagy to the actual ingestion of the corpuscles (or blood-cells) by the tissue-cells. The essential part of the function is, of course, the hæmetaboly. This may be preceded by hæmatophagy to a varying extent, or it may take place very largely outside the glandular cells, in which latter case the digestive ferment is to be regarded as being poured out of the cells and acting extracellularly.

In my endeavour to gain some light upon this most interesting subject which I am studying, I am encouraged by the remembrance that Elie Metchnikoff was also "a zoologist who wandered into the domain of medical science." Because this renowned worker—himself pre-eminently a biologist—was a pioneer in the elucidation of the subject of phagocytosis (using this term in its strict sense) and of its significance. And this subject of hæmatophagy and hæmetaboly is, indeed, only a great extension, in a new direction, of one side of Metchnikoff's work. In fact, Metchnikoff himself, by the careful attention he paid to the study of the earlier changes taking place in ingested blood-cells and corpuscles, was able to observe and note certain characteristic alterations associated with hæmetabolic activity. For the microscopical detection of the occurrence of this process, the importance of the recognition of these appearances cannot, in my opinion, be over-estimated.

In the first place, Metchnikoff describes, in his work on "Immunity" (7, p. 72, *vide* fig. 16), how the hæmoglobin of an ingested corpuscle, as it undergoes digestion in a nutritive vacuole, becomes colourless—bleached.¹ As I have noted in my preceding paper (*l.c.*) this is exactly what I found to happen first during the digestion of red corpuscles by the large mononuclears. This is a most important point to bear in mind; namely, that *a red corpuscle, in a very early stage of metabolization in a cell (or outside it, for that matter) may appear as a colourless unstaining "vacuole."* And therefore it is very necessary to be on guard against dismissing as negligible a "vacuole," approximating in size to that of a red corpuscle, contained in a cell. From the literature, I consider that this oversight has been frequent in the past; whereas, in many cases, at all events, such "vacuoles" contain in reality hæmoglobin in the first stage of hæmetaboly.

Unfortunately, this appears to be as far as Metchnikoff went in following the process; he merely says that the red corpuscles are completely digested, leaving no "remains," i.e., in the particular case he was considering, no pigment. Apparently, Metchnikoff did not ascertain that, after further alteration, this non-staining material in the "vacuole" (or, in some cases, certain portions of it) *may subsequently acquire again*

¹ Similarly, it may be mentioned, a bacterium in a digestive vacuole also loses its power of staining (*cf.* Metchnikoff's figs. 22 and 23, p. 155, *l.c.* and the figure reproduced in Adami, vol. 1, fig. 168, p. 564), the latter of which shows clearly one half of a long *Bacillus anthracis* in such a vacuole, colourless, the other half (still outside the vacuole) being deeply stained.

an affinity for stains. I have shown this to be the case, for example, during the formation of platelet-granules by the macrophages.

The second characteristic change observed by Metchnikoff was that, where two, or three, or more red corpuscles in contact or close proximity are becoming metabolized, there is a *tendency for them to lose their distinctness and run together*, as it were, *into a common mass* (cf. his fig. 9). Here, again, I may point out, this is just the same phenomenon as I have found to occur in the case of the Kurloff-body. Manifestly, there is eventual dissolution of the skin of the corpuscles and such "stroma" as they possess, and the separate little masses of hæmoglobin in course of alteration become united; the process can be regarded as a particular case of hæmolysis. Now I consider that this mode of behaviour may occur, on a comprehensive scale, extracellularly; and that in such a manner large masses of homogeneous or finely granular material may be formed; and my object in this paper is to describe one instance of the kind, that, namely, of the formation of the colloid of the thyroid gland.

The illustrations are all reproductions of photomicrographs. I wish to express my deep sense of indebtedness to Dr. D. J. Reid, for his great kindness in executing so ably the latter for me. Without his assistance I should have been at a loss, because, notwithstanding her invariable willingness to help me, I should have been most reluctant to ask Miss Rhodes to expend such time and labour as the drawing of these complicated fields of sections would have entailed. Lastly, I desire to thank most warmly all those, both friends and fellow-workers, who have in so many ways been ever ready to place their help and counsel at my disposal. Particularly would I mention, in this connexion, my friends Dr. J. D. Thomson and Dr. Ledingham and also Dr. H. M. Turnbull, the latter of whom most kindly gave me the benefit of his instructive criticism at the request of Dr. Ledingham. If, as I hope, my attempted presentment of this novel—but, I believe, correct—view, gains any support for the same, it will be largely owing to the invaluable aid given me by these gentlemen. But here, again, my expression of gratitude to them must not be taken as in any way committing them to acceptance of my conclusions.

SOME REMARKS UPON THE MICROSCOPICAL METHOD.

Before passing to the subject proper of this paper, I should like to say a few words bearing upon the method by which I am trying to study these problems, that, namely, of microscopic observation. Criticisms of work on this line often conclude with remarks to the effect, that the work is all based upon microscopic study and experiment is lacking; the inference to be drawn being that no definite position can be taken up, whether in favour of, or against the conclusions reached until experimental proof or refutation is forthcoming. Human nature being constituted as it is, essentially conservative, the upshot is that, when the question is one of a

new view *versus* an old one, the latter will continue to be accepted and believed. Any advance and progress, therefore, which might result, where the new view is more correct and more nearly represents the truth than does the old one, by the tentative recognition and adoption of the same, if only as a working hypothesis, is liable to be impeded and delayed, pending scientific proof; and this, in certain cases, may be extremely difficult to obtain experimentally.

Now, in the first place, I may say at once that I agree unreservedly that the experimental method—the dynamic method as it may be regarded—offers in all cases (where it is capable of application) a means of proving—conclusively establishing—a particular view or hypothesis; often, indeed, the only sure means. This method, of course, is in no need of defence. But, on the other hand, I maintain, *just as emphatically*, that the microscopical, or static method, of determining sequences of change or development, may afford cogent evidence indicative of the right view, if one can read it correctly. Invaluable as is the experimental method, it is *not* the only one capable of rendering good service. And I venture to think that this is inadequately recognized by many.

The last thing I wish is to be, or, to appear to be, dogmatic. In writing a paper, however, it is impossible altogether to avoid taking a positive line concerning the views and conclusions one adopts; because one cannot preface *every* sentence with the words “I think,” or “it is probable.” For instance, as regards the subject with which this paper deals, even Ebner, in the greatest work on histology extant, that of Kölliker, states in a sufficiently emphatic manner (vol. iii, p. 321) that “Die Herkunft des Colloides aus der Epithelzellen der Follikel ist wohl nicht zu bezweifeln”; whereas my observations lead me to consider that this is very greatly “zu bezweifeln.” But all the time I recognize fully that my work is not conclusively proved in the scientific sense, and I endeavour to bear in mind some wise words of Langdon Brown, in the preface to the First Edition (1908), reprinted in the Fourth Edition (1920), of “Physiological Principles in Treatment,” to which my friend, Dr. J. D. Thomson, has drawn my attention. In the following quotation I read “microscopical anatomy” for “physiology.” “When I reflect that I am now teaching the exact opposite to many of the views held ten years ago, I feel that physiology can only come to the aid of medicine with becoming modesty and without overweening dogmatism. There is no finality about either, but that they can co-operate usefully I trust the following pages serve to illustrate.”

It so happens that, as a zoologist—and protozoology is but a section of zoology—I am associated with a science which is very largely indebted to microscopical observation for its known facts and accepted hypotheses or theories. This is true of many branches of the science, and by no means least of protozoology—that branch which deals with the class of single-celled animals. Confining myself here to the latter, it is not too much to say that most of our knowledge of the life-cycles of parasitic protozoa has

been acquired by the static method—the tracing of stages and sequences by microscopical study.¹ I am fully aware of the dangers of error which, as has been pointed out, may lurk in this method ; but a protozoologist, by virtue of his whole training and the exacting nature of his practice, ought to be able, at least as well as any other biological worker, to avoid these sources of error.

It is important to remember that there are, in biology, dangers also in the experimental method, and no less care is needed in the interpretation of results so obtained. A glance at the history of protozoology is instructive in this respect. On the experimental side it is largely a record of the failure of cultural methods, owing to their inadequacy to reproduce successfully, *in vitro*, the complex conditions of the environment to which the protozoa—differentiated cells, it must be remembered—are so delicately adjusted. It is apt to be forgotten what a vast gulf separates the protozoa from bacteria, which can be cultivated far more readily and naturally. And where it has been thought that culture methods have succeeded in throwing new light upon the life-history, as, for example, notably in the case of the cultivation of certain free-living amoebæ on solid media, the results obtained are sometimes open to the serious criticism that the cells cannot be regarded as having been observed in natural conditions, and that the particular phases seen may not even represent part of a normal development.

An instance of what is in all probability such an error in the interpretation of the life-history of an amoeba, resulting from the study of its cultural development, is that of the endogenous budding, described by Colonel Glen Liston and the late Lieutenant C. H. Martin, in an amoeba from Bombay tap-water. As Dobell and O'Connor point out, in their recently published book on human intestinal protozoa, this is probably not a case of endogenous budding at all, but one of the ingestion of a small amoeba-individual by a larger one. Some time ago Dr. G. Lapage² and I had a quite similar case under our observation, where it was clear that, in cultures, the amoebæ were actively cannibalistic.

If, then, it is difficult to apply the experimental method to the relatively easily controlled free-living protozoa, how much more difficult and fraught with possible error will be the attempt to reproduce in their entirety, in cultures, the complex conditions to which the parasitic forms are specially adapted? It is, doubtless, on account of their specialization

¹ Of course, protozoologists, like other zoologists, avail themselves of the time-factor, where this can be used ; and, by fixing their material at different periods, are thus enabled to distinguish between early and later stages. Even then, however, in the case of cells, the actual phases and the sequence of changes have largely to be "constructed." And this is a very different matter from being able to watch the complete course of the development taking place normally under one's own eyes.

² I should like here to acknowledge my indebtedness to my friend and former co-worker, Dr. Lapage, M.B., M.Sc., Lecturer in Zoology at Manchester University, for much assistance in connexion with these remarks.

in response to a "tissue-environment" that the cultivation of parasites *in vitro* has helped, hitherto, in relatively slight degree towards the elucidation of their life-histories. I know, of course, that there are one or two outstanding exceptions, such as the discovery of the significance of the ex-flagellation in the malarial parasites, by MacCallum, and that of the flagellate nature of the Leishman-Donovan bodies, by Rogers. It so happens, however, that these are the first changes which occur after the transmission of the respective blood-parasites to the cold-blooded invertebrate host, and as is well known, the earliest conditions of the environment in which the parasites are in such a case are simulated very fairly by those obtaining in a culture-tube, with which, indeed, they have been often compared. But these exceptions in no way invalidate my general statement where tissue-parasites are concerned.

Finally—and this is the point I wish to emphasize—shall we not be confronted with a similar difficulty in any attempt to reproduce the various factors operating *in vivo* so closely that tissue-cells, such as those with which these researches deal, will continue, not merely to live for a time, but to *function naturally and completely* in the manner in which they were behaving before they were transplanted? Indeed, I fear the difficulty here will prove still more stubborn, because we are dealing, not with independent, more or less adaptive organisms, but with the actual units of a highly-differentiated cell-community, whose inter-relations are so finely balanced that any interference with them must, in all probability, result in some disturbance of their vital functions.

In the meantime, therefore, until culture-methods shall have become so perfected that normal cell-changes and mode of life can be actually followed at will, experimentally, I do not think it is wise to neglect whatever indications can be gained by careful microscopical study. And after an experience of over twenty years I may be permitted, perhaps, to emphasize not only the value but the very necessity of an adequate employment of this method in regard to problems of cell-life and behaviour. Indeed, *in no other way*, could I have obtained enlightenment upon this question of hæmatophagy and hæmetaboly, the importance of which, both for physiology and pathology, will prove to be, I think, very great.

In the study of any new problem of cell-life, whatever it is, thoughtful microscopical observation must come first, in order to give us some data for a hypothesis, which we can then proceed to test, where possible, by experiment. And I venture to think that, especially in the study of malignancy at the present time, a protozoologist, accustomed to the prolonged investigation of animal cells, their mode of behaviour and life-histories, could render undoubted assistance; because malignancy is a *cell*-question rather than a tissue-question. In the opinion of most, malignancy is due to some elemental biological manifestation, in an unusual and hence abnormal direction, on the part of the cells. Only quite recently, at a meeting of the British Medical Association (1920), Dr. Murray, Director of the Imperial Cancer

Research, concluded a discussion on the subject by saying that "until our knowledge of *cell-life* was more complete, we should make no great advance in cancer research" (the italics are mine). Again, a leading article in the *Lancet* (1920, ii, p. 705) sums up present-day ideas as to the cause of cancer thus: "Adami is more in line with modern conceptions of the cancer process as a profound alteration of cell-metabolism, when he ascribes malignant disease to an alteration in the activities of the cell, whereby function" (i.e., its specialized function) "becomes lost and only the power of growth remains." What is urgently needed, to-day, in the study of this question is more of the *biological* outlook.

I. THE FORMATION OF THE COLLOID OF THE THYROID GLAND.

I began to study tumours with the expectation that I should find no indications of hæmatophagy or hæmetaboly in *benign* growths, because I had then no idea that this was ever a normal function of tissue cells (apart, of course, from cells of the vascular tissue). But when I came to examine carefully some sections of an adenoma of the thyroid, which had been very kindly given by Dr. Leitch, Pathologist to the Cancer Hospital, it was not long before the conviction was forced upon me—rather against my inclination at the time, it may be pointed out (vide quotation at the head of the paper)—that hæmatophagy and hæmetaboly were occurring, the latter on a comprehensive scale. This discovery necessitated revision of my tentatively formed plan of work, and it became apparent that, before proceeding further, I must examine for myself normal tissues, in respect of the occurrence of this mode of behaviour; and I have taken first the thyroid gland.

Technique.—The normal animals used have been the rabbit and guinea-pig; nearly all the material has been obtained from the latter. Professor Korentchevsky very kindly showed me, in the first place, how best to dissect out the gland. For fixation I have used mainly my sublimate-alcohol-acetic mixture, i.e., two parts of saturated aqueous solution of sublimate to one part of absolute alcohol, with the addition of five per cent glacial acetic acid. For comparison I have used strong Flemming's solution, to which was added a few drops of two per cent osmic acid solution. Earlier workers, e.g., Hürthle [4], Müller [8], also considered these two types of fixative to be the best, and I agree with them that, of these, the sublimate-acetic mixture gives, perhaps, the better cytological results. These workers pointed out that, by the second method, the staining is at times less satisfactory, but I have obtained quite good results. Further, they considered that fixatives containing osmic acid caused rather less shrinkage of the colloid than those without. I shall have to consider this much-debated question of shrinkage or retraction, due to the fixative, subsequently, so that I will merely say here that I think too much importance has been attached to it by certain workers; but so far as regards

retraction caused by the fixation, I agree that the second method I have adopted gives slightly more correct pictures than the first.

Most of my sections have been stained with iron-hæmatoxylin plus eosin; a few, after fixation with the Flemming-osmic acid mixture, with eosin alone. For general cytological purposes, I know nothing better than the above-mentioned double stain, and I agree with Langeron's remarks upon the point in his useful "*Précis de Microscopie*"; further, there is no better stain for red corpuscles than eosin. However, following Dr. Ledingham's suggestion, I have also used the Ehrlich-Biondi-Heidenhain stain, which is said to be particularly suitable for gland-cells, and I have found this to give a nice contrasting effect. But it has not shown me any colloid-secreting cells, as was claimed by Hürthle. I would emphasize that this process which I am studying is no obscurely hidden one, which can only be revealed by some very special staining method. On the other hand, an attempt to obtain an elective "stain" or reagent for the particular ferment concerned in each case would probably be a much more difficult matter.

As regards the adenoma, this tissue was fixed in formalin, and the sections were stained with Ehrlich's hæmatoxylin followed by eosin.

THE FORMATION OF COLLOID, AS OBSERVED IN THE ADENOMA.

The condition found in the adenoma is not, of course, quite that of a normal gland, and therefore the latter ought, perhaps, to be considered first. But having regard to the special object of this paper, I think it is more useful to deal first with the formation of colloid as it is occurring in this tumour, and for the following reason. In this growth, colloid is being formed extensively and in such a manner that the beginnings of the process, i.e., the origin of the smallest masses, can be readily observed, and, in my opinion, the course of the hæmetaboly is thereby rendered clearly manifest. The objection might naturally be raised that, as I am dealing with an abnormal growth, the process of secretion may be abnormal also. To a certain extent, this is, I think, the case, but it does not affect my particular point. The entire secretion of the glandular epithelium, or the entire contents of the acini, may not correspond completely with what is present in the case of a normal gland, i.e., may be deficient in quality, a particular component being absent or occurring in diminished amount; but the colloid material itself, in so far as it represents that of a normal gland, will be produced in the same physiological manner, in both cases. We could not expect this substance to be formed in one way in the adenoma, and in a fundamentally different manner in the normal gland; and indeed in my view, it is formed in the same way in both cases.

It is not necessary for my purpose to enter here into any detailed account of the microscopical anatomy of this adenoma; I will draw attention, therefore, only to such points as are relevant. This localized tumour is of the type showing both active increase of colloid-forming tissue

and storage of colloid; it is of the nature of a colloid goitre. The acini, or follicles, vary greatly in size, some being very small, others of relatively enormous diameter; the lumina are filled with almost homogeneous, pink-staining colloid. In some cases, the lining epithelium of two fairly large, adjacent tubules is practically in contact, there being little or no interfollicular tissue, or stroma, between the two epithelial rows. But minute capillaries, containing a few red corpuscles, and, apparently, also isolated corpuscles, can always be found. Indeed, this is the first point that strikes one as noteworthy; after the epithelial cells, the next most common "cellular" elements, recognizable as such, are the red corpuscles.

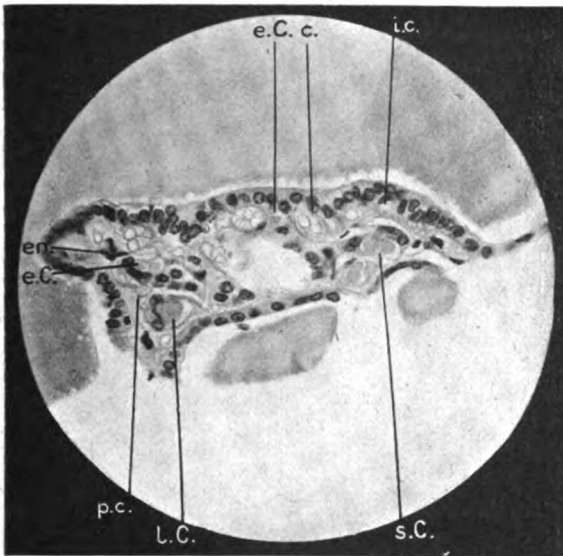


FIG. 1.—To show the condition in an interfollicular zone of the adenoma. Numerous corpuscles (c) in small capillaries are seen immediately outside the epithelium; en., endothelial nucleus (just above it is the nucleus of a polymorph); p.c., pale corpuscle; i.c., corpuscle definitely intracellular, in an epithelial cell; e.C., small masses of early colloid, pale pink, formed from separate corpuscles; s.C., separate small masses of fully formed colloid (strong pink); note the epithelial nuclei in close relation; l.C., larger mass of colloid (more lobulated than appears in the photo) resulting from the fusion of three or four separate masses (as at s.C.). ($\times 300$.)

In this tumour, however, much more frequently the two regular epithelial rows, bounding neighbouring, fully developed acini of any size, are separated by a certain amount of interfollicular tissue. Such a small¹ interfollicular zone (figs. 1-3), is chiefly occupied by blood-capillaries containing corpuscles, and by cells, irregularly disposed, occurring singly or in small

I am not considering, in this connexion, wide interfollicular areas, where there is connective tissue (cf., for instance, the narrow zone in the middle of fig. 3, with the band of connective tissue stroma at the right-hand side).

groups; these cells are similar to those constituting the follicular epithelium. From the agreement in the character of the nuclei in the two cases, there can be no doubt, I think, that these interfollicular cells and cell-groups are also epithelial cells, which have been derived from the epithelium of an acinus. The sparsely occurring, narrow, endothelial nuclei can be distinguished without difficulty. In addition, in such an interfollicular zone, the smallest masses of colloid are to be found, and their mode of formation can be studied.

The small capillaries containing red corpuscles (c, figs. 1 and 2) usually lie close to the epithelial row of cells bordering the lumen of a follicle. Occasionally, solitary corpuscles are seen, definitely inside a cell; this intracellular situation is indicated by the fact that, in such a case, the cell nucleus is nearly always crescentic in form, wrapping partially around the ingested corpuscle (cf. fig. 1, i.c.) in the characteristic manner I have frequently pointed out. But in this first example which I am considering, that of the formation of the colloid, it so happens that the occurrence of hæmatophagy, followed by the complete metabolization of the corpuscles while inside the cells, is not common; as will be seen later, normally, the corpuscles pass either through or between the cells, into the lumen of the follicle, and the hæmetaboly is completed there. Only in this abnormal growth, complete intracellular metabolization is, I consider, occasionally to be observed.

The varying appearance of the corpuscles is most instructive. Normal corpuscles are more or less crinkled, very refringent, and of a bright orange-pink colour, i.e., pink, together with a slight but definite tint of orange. Many of the corpuscles, however, are distinctly pale, or even practically colourless; not only in the case of intracellular corpuscles, but also where they are extracellular, either solitary, or in groups of two or three together in a capillary (p.c., figs. 1 and 2). This is no merely haphazard staining effect; in the same field can be seen both brightly stained and pallid corpuscles. The difference is due to the fact that the corpuscles themselves, in the latter case, are becoming bleached and losing their affinity for the stain; in other words, the first characteristic alteration noted above as occurring during the metabolization of hæmoglobin, is taking place. Corpuscles which have penetrated into a mass of colloid and are beginning to undergo this metamorphosis, show this appearance very clearly; as they gradually lose their corpuscular distinctness, they are most liable to be mistaken for "vacuoles" in the colloid (cf. different stages in fig. 4).

The next important point to note is that, often, in close relation with these capillaries, and especially with those in which the corpuscles are pale, there are one or two of the interfollicular epithelial cells already mentioned (ep., fig. 2); in such cases, the nucleus, particularly, of these cells appears closely applied to the wall of the capillary, i.e., in as close proximity as possible to the contained red corpuscles.

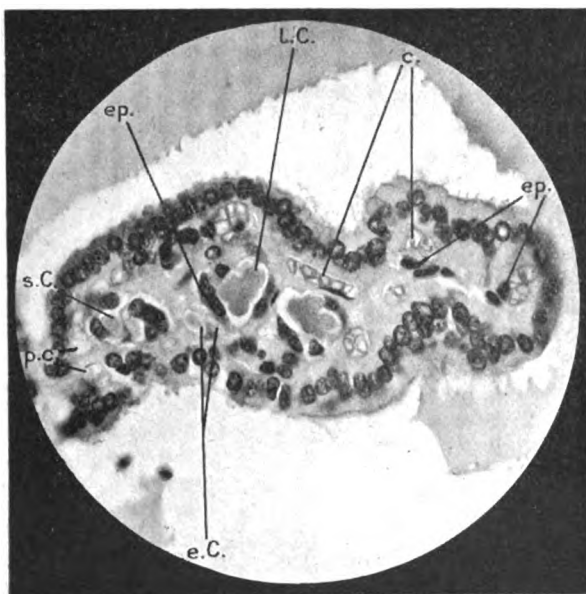


FIG. 2.—Interfollicular area, showing colloid-formation. c., minute capillaries containing normal corpuscles; the one to which the left-hand branch of the arrow points shows an endothelial nucleus, for comparison. Near the right-hand end are seen two such capillaries, with which interfollicular epithelial cell nuclei (ep.) are in close relation. p.c., pallid (bleached) corpuscles. e.c., small masses of early colloid, corresponding in size to red corpuscles. s.C., three small separate masses of fully-formed colloid; note the epithelial nuclei in close relation. l.C., larger masses of colloid, lobed in outline; interfollicular epithelial cells are becoming arranged around each, in the commencing development of a small acinus. ($\times 400$.)

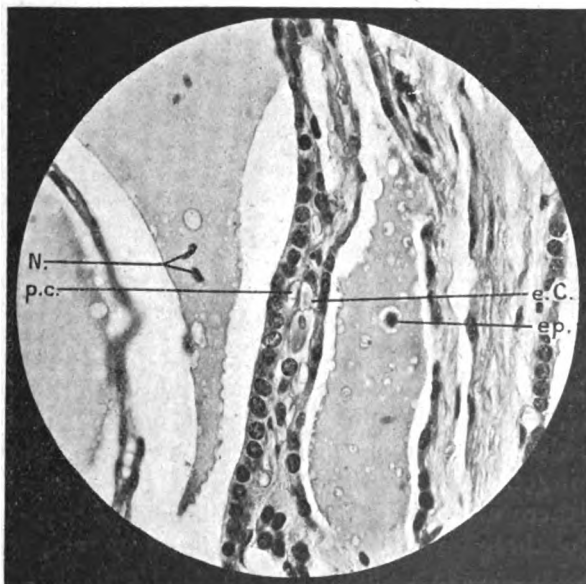


FIG. 3.—Narrow, interfollicular zone, with colloid on either side. p.c., pallid corpuscle, and alongside it, a corpuscle altered into early colloid (e.C.). Note the interfollicular epithelial nucleus immediately above the latter. Below it is a small mass of fully formed colloid, resulting from two or three corpuscles. N., leucocyte nuclei included in the colloid. Ep., effete epithelial cell, similarly included. ($\times 300$.)

In its earliest recognizable form, the colloid occurs as very small masses, each approximately the size of a single corpuscle; I have never found any smaller than this. These small masses (e. C. and s. C., figs. 1—3) occur either singly, or in groups of two or three in contiguity. At first they stain faintly pink—a uniform, pale pink—with no trace of orange; and they are not crinkled and refringent in appearance. At a later stage the colour increases in intensity, until it is a strong pink,—that of the large masses of colloid in the large acini bordering such an area as I am describing. Further, where two or three or more of these small separate masses are in contact, they soon run together, or unite into lobed masses of more

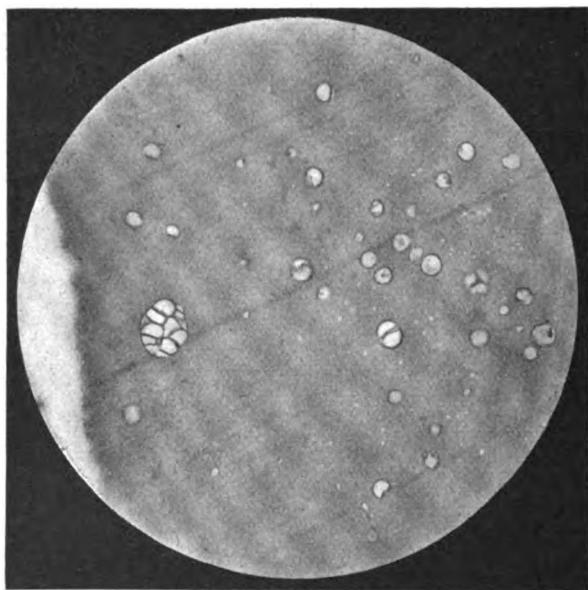


FIG. 4.—To show pallid (bleached) corpuscles included in a mass of colloid, both separately and in clumps. Here and there individual corpuscles are losing their distinctness, and beginning to stain faintly pink. (From the adenoma; $\times 450$.)

conspicuous size (l. C.). Equally in close relation with these small masses of early colloid, are to be found the nuclei of interfollicular epithelial cells. Where there is a single little mass, there is a single nucleus in relation with it (cf. e. C., fig. 3, the nucleus lying just above the little mass); where there are two or three small masses close together, there are often two or three epithelial nuclei (cf. figs. 1 and 2); and where there are larger, lobed masses of colloid, the epithelial cells in relation are now more in number, and are gradually becoming ordered and arranged to form the beginning of a small acinus or follicle (l. C., fig. 2).

A word or two as to the origin of these interfollicular epithelial cells,

because this is of importance in regard to my observation of the formation of small, independent masses of colloid. I consider that the appearances I have described indicate the proliferation outwards, i.e., into the interfollicular zone, of a few cells of the epithelial wall of an acinus, which become more or less separated, and tend to lie in the immediate neighbourhood of minute capillaries; such an indication of proliferation can be seen in fig. 2, both from the upper, and from the lower part of the wall. In regard to these particular cases, it is *not* a question of bays or projections, whether inwards or outwards, of the actual wall of an acinus; such bays being regarded as running more or less vertically to the plane of the section, and thus appearing detached from any large acinus to which they might really belong. Bays do occur, of course; fig. 2 itself represents a large bay projecting inwards into a huge mass of colloid in an acinus. But, in the first place, apart from these obvious, massive foldings, the outline of the wall of the great majority of the follicles is very regular; at the most, slight bendings are seen. And nowhere can any appearance be found comparable to the numerous little angular projections which would be present if the condition I have dealt with were so produced. Further, this explanation could not apply in any case, I consider, to the groups of two or three detached cells, or even a single one, in relation with a capillary or small masses of colloid. Where a small, but regular and complete acinus occurs, apparently isolated in an interfollicular zone, this may be, sometimes, only a projecting tongue of a large follicle out of the plane of the section; though even as regards many of these I think they represent, rather, a later stage of the development seen, for instance, in the middle of fig. 2.

On the above grounds, I consider that these small masses of colloid *are formed by the metabolization of the red corpuscles*, the hæmetaboly being effected by means of a ferment secreted by the nucleus of the epithelial cells in immediate relation. Indeed, taking in conjunction the results of my previous work on this subject and the appearances I have now described, I do not think any other explanation can reasonably be given. We have seen that many of the corpuscles, still recognizable as such, are nevertheless, in the pallid, bleached condition known to be the first sign of alteration shown by a corpuscle in process of digestion, or metabolization. Next we have, in place of these, small bodies of the same size, occurring singly, or in groups of two or three, no longer crinkled and refringent but commencing to take up the stain again, the colour being faint at first. Compare the single pallid corpuscle (p.c.) in the middle of fig. 3, with the small mass of early colloid (e.C.), immediately to the right; and again, groups of two or three corpuscles, as seen in cross-section of a small capillary, with clumps of two or three small, separate masses of colloid, all of about the same size. The difference in appearance between these two sets of elements is of an order perfectly comparable with that between the red corpuscles and small Negri-bodies, as seen in a section

(cf. my earlier paper, fig. 14, A). Further, the fusion of separate contiguous masses of colloid into one larger, lobed mass, the very lobes of which indicate clearly this mode of origin of such a mass, is entirely comparable with what I found to occur in the case of the Kurloff-bodies; compare my fig. 11, l.c., which shows two small Kurloff-bodies in one lymphocyte, separately formed from two corpuscles, about to unite into one mass. This process represents in short, the second characteristic alteration during the metabolization of hæmoglobin, shown by Metchnikoff to occur, to which I referred; namely, that as the digestion proceeds and the skin of the corpuscles is dissolved, the separate masses of hæmoglobin in course of alteration unite together into one.

I can find not the slightest evidence of the secretion of the colloid material, in or by the cells themselves. And, indeed, as regards the inter-follicular epithelial cells, these apparently possess very little cytoplasm with which to do any secreting; at all events, it is most difficult to definitely distinguish any cytoplasm from the general ground-substance in which the cells lie; whereas, the cytoplasm of the follicular cells is plentiful in amount and readily distinguishable. In this respect, of course, this adenoma differs from the normal condition; but the difference is very instructive, as indicating the important part played by the cell-nucleus, which, in my opinion, secretes the ferment concerned in the hæmetaboly.

It is the nuclei themselves which come to lie so close to the minute capillaries. And I consider that, in the case of this tumour, the corpuscles are being metabolized, in general, while they are still actually in the minute capillaries, the ferment either passing through the delicate wall, or, probably, sooner or later dissolving the wall itself. Thus, to refer again to fig. 3, just as the pale corpuscle (p.c.) is inside a minute capillary, so the corresponding small mass of early colloid (e.C.) alongside this is also inside a minute capillary, closely applied to the wall of which is the active, ferment-secreting nucleus; and similarly with regard to the little groups of two or three small masses of colloid (cf., in fig. 1, c. with s.C.).

As regards the result of this metabolism of the red corpuscles, there is one important and essential difference from what is found, for instance, in the case of the production of Kurloff-bodies and Negri-bodies; (I mean, of course, as regards the microscopical appearance). *There are no pale unstained inclusions*, i.e., no "inner formations." The hæmoglobin is not, as in those cases, broken up into two separate compounds, one of which contains the iron-compound and the other some proteid substance; on the contrary, it is metabolized into one uniform material, colloid, which contains, most probably, all the hæmoglobin in the form of another complex organic compound.

The only "inclusions" which may be present in masses of colloid, apart from red corpuscles in various stages of alteration, are occasional cells, or their nuclei, which latter remain longer recognizable (cf. fig. 3, in the colloid masses both right and left of the centre). Some of these

are leucocyte-nuclei, but others are those of effete epithelial cells. In sections of normal thyroid, also, clumps of old, disorganized, epithelial cells can be seen becoming metabolized in the lumen; Hürthle [4] also describes and figures follicles containing such effete cells. I think it is quite probable that these elements also can be metabolized into colloid material; in just the same way as the ferment produced by the megakaryocytes can digest not only corpuscles, but also "free" nuclei and leucocytes, with the resulting formation, ultimately of platelet-granules and platelet-cytoplasm.

It is important to note that, notwithstanding this metabolization of the red corpuscles on such a comprehensive scale, no pigment is apparently produced, whether ferruginous or melaniferous; at any rate, I have never found any, and Hürthle (l.c.) also states that he never observed any pigment.

THE CONDITION AS FOUND IN THE NORMAL THYROID.

I pass now to the consideration of the normal thyroid; and I may say at once that the condition found here fully bears out the conclusions at which I have already arrived.

In the first place, I desired to ascertain what became of all the iron of this quantity of metabolized hæmoglobin. In the light of what I had learnt from studying the adenoma, I formed the opinion that it must be contained in the colloid. To determine this question, my procedure followed that adopted in the case of the platelets and platelet-cytoplasm. In sections stained with iron-hæmatoxylin alone, and scarcely differentiated at all, the appearance seen is that of fig. 5. As I have shown in my first paper, those elements and parts which are stained densely black are those which contain iron. These are: all the cell-nuclei, the masses of colloid, and a mass of red corpuscles in a large capillary or sinus in the lower, right-hand quarter of the field. Even from this field, as seen at a fairly low magnification, it is clear that the cytoplasm itself of the cells contains no iron. *But all the colloid contains iron*—just as does the hæmoglobin of the corpuscles. This conclusion was verified by the application of Brown's modification of the ferrocyanide test for "masked" iron, in the manner previously described. The blue reaction of the colloid stands out in marked contrast from the pale, "unstained" character of the cytoplasm of the cells themselves, and is relatively almost as pronounced as it was in the case of the Kurloff-bodies. Apart from the chromatin of their nuclei (which, of course, also gives the blue reaction), *the epithelial cells of the thyroid do not appear to contain any iron*. These observations strongly support, therefore, I consider, my view that the colloid is derived from the hæmoglobin of the red corpuscles; and that there is nothing of the nature of colloid actually in the cells themselves.

The next question was, How, normally, does the blood gain access to the lumen of the acini or follicles? I have already indicated how abundant

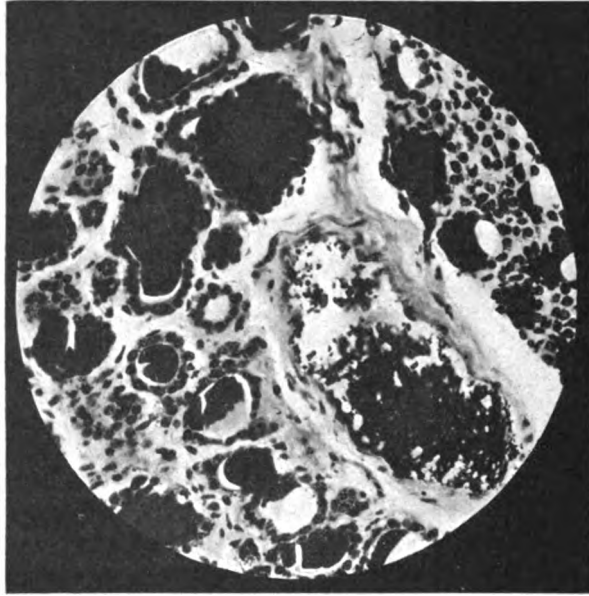


FIG. 5.—Section stained with iron hæmatoxylin alone, and merely rinsed subsequently with the mordant. To show the distribution of the iron; iron-containing elements black. (For description see text.) ($\times 250$ approx.)

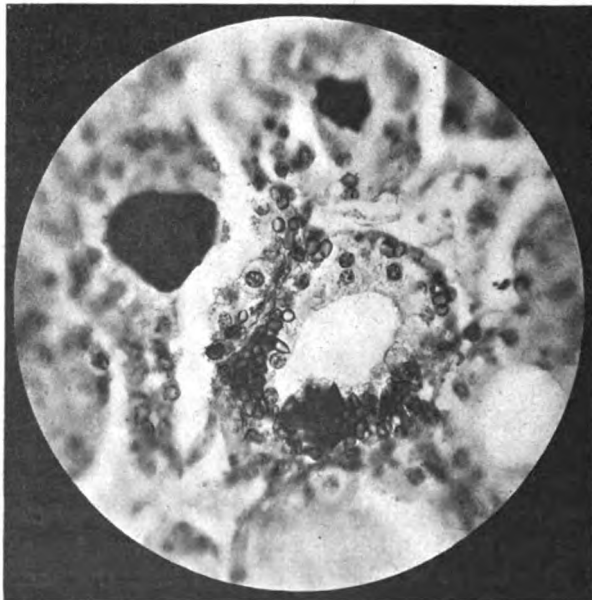


FIG. 6.—To show diapedesis of a mass of corpuscles through the epithelial wall, into the lumen of an empty acinus. On the left-hand side is a narrow, pointed corpuscle, passing between two epithelial cells, which has almost gained the lumen. The innermost corpuscles of the mass in the lower part of the wall are similarly pointed as they are forced through, but these are not quite in sharp focus. (Iron-hæmattox. + eosin; $\times 400$.)

the small capillaries, containing especially red corpuscles, are in the inter-follicular zones of the adenoma; and I found just the same to be the case in the normal thyroid, even though the acini are, in general, here very closely apposed to each other, i.e., there is extremely little interfollicular tissue, apart from the capillaries. And I have obtained ample evidence that the corpuscles *pass by diapedesis, either through or between the epithelial cells, into the lumen of the follicle*; this is brought about, most probably, by local and temporary increases in the blood-pressure. In a quiet way, this passage of the corpuscles, by twos and threes, from the outer to the inner side of the epithelial wall, is, I should say, regularly taking place; but in addition, as it were in bursts, masses of them are forced through, causing local disruption of the epithelium. In fig. 6, this process is clearly shown. The iron-hæmatoxylin has not been completely extracted from the corpuscles, so that these stand out clearly. Around the upper side of the acinus in sharp focus, clumps of corpuscles are seen in very close relation to the epithelium: some, indeed, have already penetrated into the cell-row. Spreading upwards, at the left-hand upper side of this acinus, are more corpuscles, between adjacent follicles. And, in the lower half of the follicle, corpuscles *en masse* are being forced through the wall into the lumen, which is empty of colloid. On the left-hand side, two individual corpuscles, in sharp focus, are seen passing through between the cell-borders, the lower one of them being elongated and pointed. Again, in figs. 11 and 12, just the same occurrence is happening in the right-hand wall of the larger follicle. While, in fig. 7, numerous, mostly pale, corpuscles are seen, completely inside the lumen, in and amongst the colloid already present (stained black), the two together completely filling the cavity of the acinus.

An excellent composite picture of the various stages in hæmetaboly is afforded by the follicle shown in fig. 8. Normal corpuscles (n. c.), still retaining the hæmatoxylin stain are seen; just outside the epithelium, passing through the cells, and in the lumen, amongst the colloid already present, which has been formed from a precedent influx of corpuscles. Further, pallid (bleached) corpuscles (p. c.) are also present, both outside the epithelium, in the cells, and just inside the wall of the follicle, where they appear as "vacuoles" at the edge of the colloid. This is a very common situation for corpuscles in the first stage of alteration to be met with, and it indicates, in my opinion, the frequent passage, in a modest fashion, of a few corpuscles through the wall into the lumen. Two or three of these pale corpuscular areas at the periphery of the colloid do not happen to be in sharp focus, because I wished to show the central corpuscles sharply focused, for the reason to be given.

In addition, a mass of corpuscles, in different degrees of paleness, fills up a large portion of the lumen of the follicle. And the important point to note is, that the four innermost corpuscles of this mass, lying practically in the centre, are again beginning to take up the stain. These four

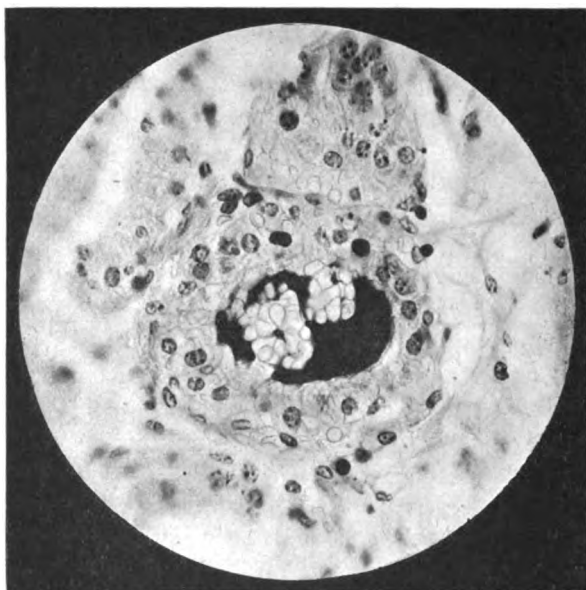


FIG. 7.—An acinus whose lumen contains a number of pale corpuscles, which have penetrated into the colloid already present, the two together completely filling the lumen. (Iron-hæmatox. + eosin; $\times 400$.)

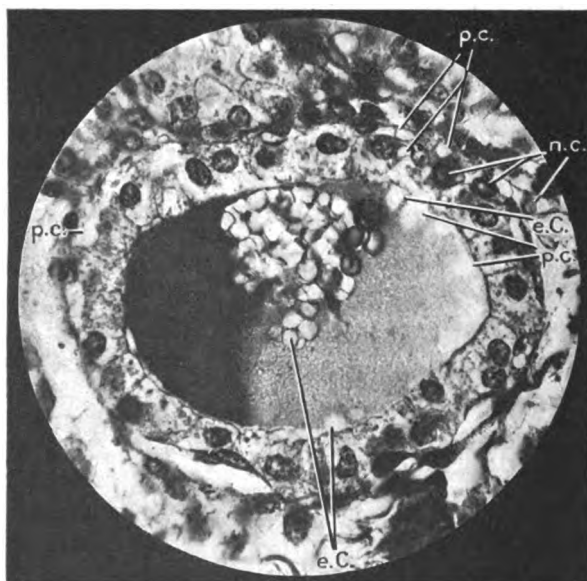


FIG. 8.—To show the different stages in the course of the metabolism of red corpuscles into colloid, occurring in a single acinus. n.c., normal corpuscles; p.c., pallid corpuscles; e.C., early colloid, staining pale pink. (Iron-hæmatox. + eosin; $\times 550$ approx.)

corpuscles (e.C.) are stained a uniform, pale pink with the eosin, the same colour as the pink portion of the colloid, around them, but lighter in tint (cf. above, under the account of the adenoma). That is to say, *the metabolized hæmoglobin is now in the stage of early colloid*. The substance is still apparently homogeneous in appearance, and not yet of the finely granular character of the surrounding colloid.¹ That change, together with the ultimate dissolution of the delicate corpuscular "skin" is all that has to occur before the metabolization will be completely effected and the newly formed colloid merge indistinguishably into that already present. Besides the four central corpuscles, one at the periphery (right-hand upper corner, nearest to the still normal corpuscles in the lumen) is also in the same stage of early colloid; one or two others, around the periphery, show the merest trace of pink, though this is not apparent in the photo, because they are not quite in focus.

Thus, in addition to the fully formed colloid material, in the lumen of this follicle there are corpuscles in three different conditions, dependent on how long a period had elapsed since they had penetrated into the lumen: (1) normal corpuscles, like those still in the epithelial wall (right-hand side), which can only very recently have passed in; (2) pale corpuscles, which have been in the lumen a little longer; and (3) metabolized hæmoglobin, staining uniformly light pink, in the stage of early colloid. As regards the pallid corpuscles, it must be borne in mind that this change may occur also while the corpuscles are passing through, or even before they have entered the lumen (cf. this fig.); this variation depends most probably on whether the epithelial cells in immediate proximity to the particular corpuscles, are at the moment in an active, or quiescent state.

Lastly, I have caught a most interesting stage in some sections of material fixed in the Flemming-osmic acid mixture, which had been stained with eosin only, in order better to detect any fat, blackened by the osmic. The fixation of the colloid, therefore, may be regarded as being most satisfactory (*vide* under technique). In such a section (fig. 9), the normal corpuscles are a deep red-pink, while the colloid is a lighter and brighter pink colour. As already mentioned, the colloid appears, after this fixation, most finely granular, i.e., most nearly uniform. Now, here and there, in certain of the acini, by careful focusing, it can be seen that the colloid shows in part, or even very largely, the appearance of a delicate mosaic. Dr. Reid has succeeded in bringing out this faint mosaic appearance in a photomicrograph, by using a green screen, which in-

¹ The colloid in the normal thyroids I have examined, both of guinea-pig and rabbit, appears very finely granular, and not homogeneous, as in the case of that of the adenoma studied; I have found it to be in this condition, whatever fixative has been used; it is most finely granular—most nearly homogeneous—after the Flemming mixture. Various writers on the thyroid (e.g., McCarrison [6], and compare also Jordan and Ferguson [5], p. 557), state that the colloid may appear either homogeneous, or else finely granular.

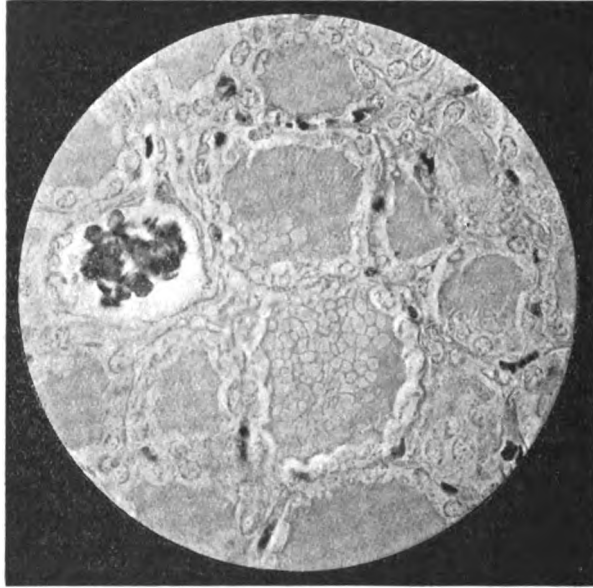


FIG. 9.—The last visible stage in the metabolization of the corpuscles into colloid. A large part or nearly all of the colloid in the four acini seen in the middle, vertical row appears as a delicate mosaic, representing the individual, closely aggregated corpuscles; these are only delimited by the still persisting, delicate "skin" of the corpuscles, which will ultimately disappear. The whole mass is the pink colour of formed colloid. The little dark masses are the normal corpuscles; on the left a number are seen in a capillary. (A green screen was used to obtain the best effect.) (Flemming-osmic acid; eosin alone; $\times 400$.)

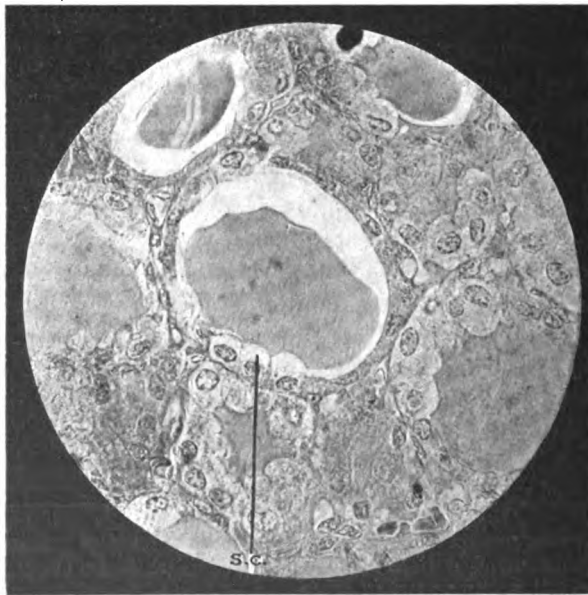


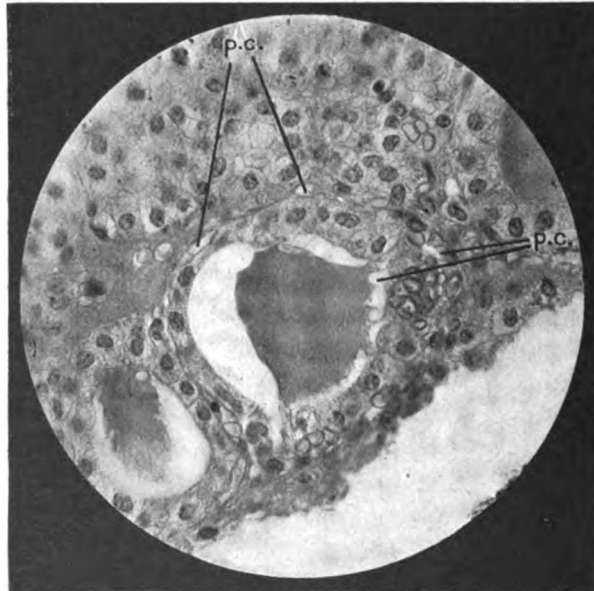
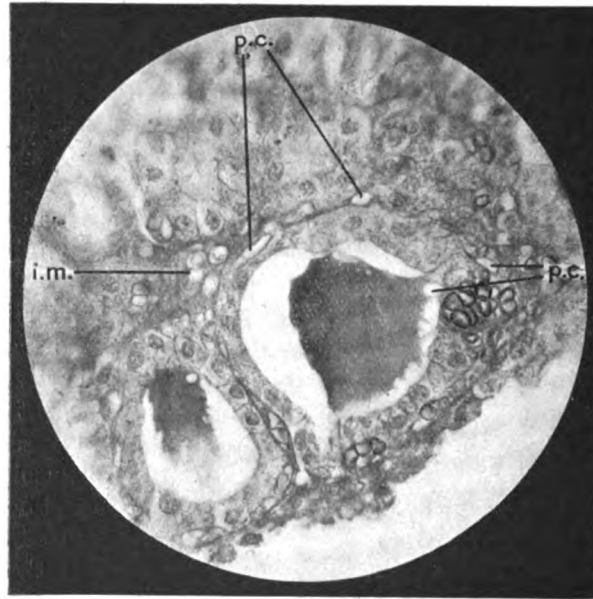
FIG. 10.—From the same section. The colloid in the middle follicle has quite lost the mosaic appearance. s.c., epithelial cells commencing true secretion (see text and fig. 15). Note the flattened epithelial cells in the upper side of the wall, which have finished secretion. (Flemming-osmic acid; eosin alone; $\times 450$.)

tensifies the pink and, incidentally, makes the normal corpuscles appear very dark. In fig. 9, three or four acini are shown, the colloid of which presents this appearance; it is best seen in the two middle follicles, which are in sharp focus. Here a large portion, or nearly all of the pink colloid consists of a number of small areas, separated from each other and delimited by a delicate, but distinct skin or membrane, which appears a trifle darker than the areas themselves.

I do not think there can be any doubt that this appearance of the colloid indicates the last stage distinguishable in the metabolism of a mass of red corpuscles, before all trace of their individuality is lost. If this figure is compared with fig. 7, it will be realized, I think, that the former represents a later stage of the condition shown in the latter. There is the same slight variation in size, according to the form of the particular corpuscle and the direction in which it was lying; the same slight angularity is often apparent, due to the corpuscles having been closely pressed together. The only difference is that whereas, in fig. 7, the corpuscles are mostly pallid, in the later stage of fig. 9, they are now pink and almost completely metabolized into colloid. In other words, a large part of the colloid in these particular acini is in the same stage as that of the four central corpuscles in fig. 8, as above described.

Ultimately, the delicate skin also disappears and we have a uniform mass of colloid, as in fig. 10, taken from the same section; and, of course, the fully formed colloid present in most of the follicles is in this condition. In this respect, therefore, the formation of the colloid in the normal gland differs slightly from what I found to be the case in the adenoma. As regards the active new formation of colloid, in small masses in the interfollicular areas, I think the corpuscular skin is very quickly dissolved and the smallest masses completely unite to form larger ones, lobed at first. I saw no indication of this persistence for a time of the skin, and I am inclined to explain this difference by the very close relation in which the epithelial nuclei, which secrete the hæmetabolic ferment, come to lie with the corpuscles in these interfollicular zones of the adenoma.

The colloid itself shows considerable variation in regard to its staining appearance. In the first place, when stained with iron-hæmatoxylin and eosin, in some acini the colloid has all retained the hæmatoxylin and appears uniformly black; in others, it has entirely lost the black stain and is all pink with the eosin; while in, perhaps, the majority of cases, part is black and part is pink (cf. figs. 6 to 8). As these various appearances can be seen in neighbouring follicles of the same section, they are not the result, merely of different degrees of extraction, according to difference in thickness (comparable with what is met with sometimes in films, as I explained previously). Certain masses of colloid, or portions thereof, retain the iron-hæmatoxylin more firmly, i.e., have a stronger affinity for the stain, than have others. And this difference in staining appearance is present also when the colloid throughout is stained with



FIGS. 11 and 12.—Both figures show the same field: from a section stained by the Ehrlich-Biondi-Heidenhain stain, after the use of different screens; fig. 9 to bring out the red-pink stain (mostly the acid-fuchsin), fig. 10 to bring out the methyl-green (only the nuclei are so stained). Note the recent inbursting of normal corpuscles through the wall of the larger acinus, on the right-hand side. p.c., pallid corpuscles, both outside the wall and just inside the lumen, at the periphery of the mass of colloid. At the left side of the larger acinus, interfollicular metabolism of corpuscles is proceeding, (i.m.). ($\times 400$.)

only one colour. Thus, in the adenoma above described, portions of the colloid, especially in large follicles, may be a much stronger red-pink (with the eosin) than the rest (cf. the mass of colloid above the inter-follicular area in fig. 1). Again, after the Ehrlich-Biondi-Heidenhain stain, a quite comparable variation is found; in figs. 11 and 12 (of a normal thyroid), the left-hand portion of the large mass of colloid is a much stronger red-pink (with the acid fuchsin) than is the remainder. My inclination is to think that such more intensely staining parts of the colloid are older, that is to say, have been longer formed than the rest.¹

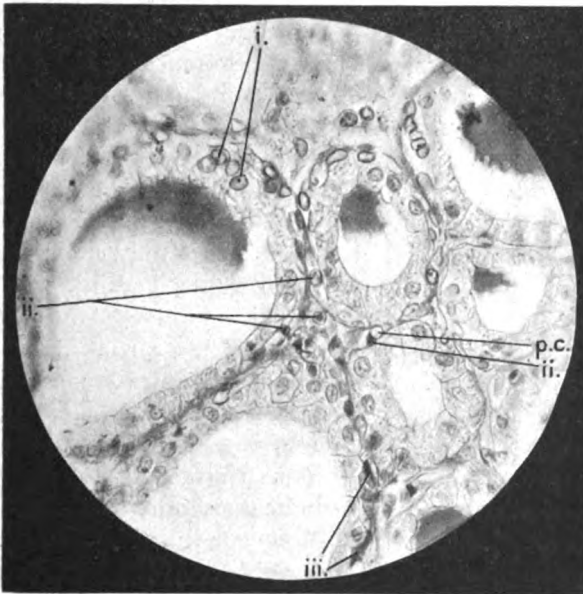


FIG. 13.—To show the modified course of the metabolism of the corpuscles. p.c., pale corpuscle; i, slightly pale corpuscles with one or two conspicuous granules; ii, clumps of granules, or a compact, red-staining mass in the middle of the corpuscle; iii, elongated intensely staining, granular masses. (E.-B.-H. stain; $\times 400$.)

While the course of hæmetaboly is mainly as described and results in the formation of colloid, I have indications that, in some cases the metabolism of the red corpuscles appears to follow a slightly modified course. This modification occurs usually, so far as I have seen it, between the acini, i.e., in the interfollicular zone and not inside the lumen; though exceptionally I have found corpuscles undergoing metaboly in this modified form both in the epithelial wall and in the lumen itself. But I do not think that this process results in ordinary colloid.

¹There is also a corresponding variation, to a slight extent, in the intensity of the blue reaction after the ferro-cyanide test; it would appear as if the iron in the older colloid tended to become less firmly "masked."

The microscopical appearance of the product in this case is granular, more coarsely granular than is ever the colloid material, however fixed; and after the Ehrlich-Biondi-Heidenhain stain, these granules are a strong red-pink colour, which is distinctly redder and stronger than the colour of the colloid. This type of alteration of the corpuscles can be detected in preparations stained with iron-hæmatoxylin by the coarseness of the granules, but on account of their staining intensity and conspicuous character after Ehrlich-Biondi-Heidenhain, I figure the condition from a section so stained (fig. 13). In this case, the usual preliminary bleaching of the corpuscles is not so marked; they do not altogether lose their staining affinity, but they stain more faintly. In certain of these paler corpuscles, one or two conspicuous granules are present (indicated by arrows marked i, fig. 13); in others, several granules are seen; while in a later stage, a compact, red-staining mass or clump of granules occupies the middle of the corpuscle (indicated by arrows marked ii), the remainder of which is now pallid except for the skin around the margin.¹ Ultimately, all recognizable remains of the corpuscle disappear and small, compact, intensely staining granular masses, often elongated, resulting from separate corpuscles, are seen sandwiched between neighbouring epithelial rows (indicated by arrows marked iii).

It is interesting to note that, in this mainly extra-follicular form of hæmetaboly, I have not observed any fusion or running together of the altered corpuscular masses. They do not form large masses comparable to masses of colloid. Further, the ordinary process of hæmetaboly, resulting in colloid, is never (normally) completely performed by the epithelial cells on their outer side, i.e., with regard to the corpuscles still in the inter-follicular capillaries. As already indicated, only the earliest stage, the bleaching of the corpuscles, is found to occur in this situation. One reason why this is the case may be suggested. If the complete formation of colloid could take place normally on the outer side of the epithelial cell-row, masses of colloid formed from united corpuscles would be met with in the capillaries themselves, and these would tend to be blocked and the circulation thereby impeded. On the other hand, in the abnormal growth, the adenoma, this intra-capillary formation of colloid is occurring and on a large scale.

(*To be continued.*)

¹ In this stage of the metabolization, some of the altered corpuscles might be thought to simulate slightly nucleated cells, e.g., lymphocytes; but it must be remembered that the colour is not the blue-green of all the nuclei, but a red-pink.

FRAGMENTS.

BY COLONEL SIR ROBERT FIRTH, K.B.E., C.B.

XXX.

I HAVE elsewhere¹ expressed the opinion that man's values do not change however much his rites and ceremonies may do so. The truth of that opinion is confirmed by a study of the analogy between the magical and the scientific conception of the world. In both, the succession of events is regular and certain, being regarded as determined by immutable laws, the operation of which can be foreseen and calculated, the elements of caprice, chance or accident being banished from the course of Nature. It is true that the savage races are unable to conceive of constant relations between cause and effect, and that the *how* and the *why* of things is a late conception of human development, but what appears to rule the life of man at his highest and his lowest and to persist in often unexpected form is the sense of a vague, impersonal, ever-acting, universally diffused power which to borrow a word for it, common to the whole Pacific, is called *mana*. This is the stuff through which the so-called magic of old days worked and claims to work now ; it is not the trick itself, but the power whereby the sorcerer does the trick. Under various names we meet it all over the world, it is *wakonda* to the Omaha Indian, *orenda* to the Iroquois, *manitou* to the Algonkin, *kutchi* to the Australian aboriginal, *bu-nissi* to the Bantu, *n'ga* to the Masai and was *physis* to the Greeks.

There is an old controversy as to the relation of magic to medicine and religion. Into this I do not propose to enter at length. It suffices to say that beliefs vanish before the advance of knowledge and the heterodoxy of yesterday becomes the orthodoxy of to-morrow. Certainly there is no church of magic, and to some extremists, who aver that there is no church without it, all ceremony abides as a vehicle for magic and therein the medicine man and the minister meet together. To this, I frankly do not subscribe. Magic is founded on an association of ideas by similarity and on an association of ideas by contiguity. The principle of association applied legitimately yields science, applied illegitimately it yields magic. To the extent that it deals with impersonal forms and through them aims at control of individuals by positive and negative precepts, magic is opposed to both religion and medicine. The positive precepts are charms, the negative precepts are totems and tabus, all more or less endowed with a sanctity. The sacred which is not divine and the sacred which is divine are by definition cut off from each other. In spite of this, it is going too far to say that those who follow magical rites or regard totems and tabus

¹ This Journal, September, 1921, p. 203.

are devoid of religion or that attitude of mind which visualizes the conception of how to ascribe our well-being and renewal, not to ourselves but, to the higher powers that are with and in us, and yet are never merely us. Even savages and simple folk in their view of the universe put the moral aspect above the mechanical and have an ethical code or way of life and, because of that, we are not justified in refusing to recognize the existence of a non-theistic type of religion. The essential difference between magic on the one hand and medicine and religion, as we understand them, is that the first stands for maleficent and anti-social or individualistic ways of exploiting the unseen and the occult, while the two others stand for all such ways of dealing therewith as are supposed to further the common welfare. There may be, undoubtedly, a survival of an element of magic in some theologies but theology is not equivalent to religion, and a way of life, whether it employ spell or prayer as its medium of expression, is essentially an effort to realize values of a spiritual rather than a mechanical order. We may say, therefore, that magic preceded and prepared the way for both modern medicine and religion, but is antagonistic to the newer or intellectual developments of both.

This being so, it may surprise some to know that magic, *mana*, *physis*, or whatever name we like to give it, plays an important part in many modern beliefs and customs, not only among backward peoples but among ourselves, finding refuge in such varied things as blood, hair, teeth, saliva, shadows, reflections, echoes, names, passwords, curses, spells, charms, amulets, mascots, mantrams and drugs. The equation of blood with life is mentioned in the Iliad where the soul of Hyperenor is described as fleeing hastily through the stricken wound, while an Arab of to-day will tell you that the life of a slain man flows on the spear point, and a Bengali will spit upon and carefully throw away spilled blood to prevent any mischief being done to the wound from which it flowed. The peasants of Galway say that it is unlucky to give or receive hair-cuttings and, if these are stolen, ill will befall the thief; in Leitrim, rustics keep their hair-clippings because they may be wanted on the day of judgment to turn the scale against the weight of their sins.¹ The occult power believed to dwell in the hair is explained by its connection with the head to which a special sanctity has been attached as the dwelling place of the spirit. We all know how when Delilah cut off the seven locks from Samson's head his strength went from him. Yorkshire yokels constantly preserve cast teeth so that the owner may not lack them at the resurrection. Conversely, in Somersetshire, shed teeth are thrown away or burnt lest magic be worked through them and evil befall the late owner or his parents.² Since the days of Aristotle and Pliny, belief in the potency of saliva has been world-wide, and we meet with its use as a benediction, a luck-bringer, a love-charm, a lustration against the

¹ "Folk-lore," vol. vii, p. 182.

² "Rustic Speech and Folk-lore," by E. M. Wright.

evil-eye, and as a symbol of friendship. In the South Sea Islands and on the Congo, the higher a man's rank, the more sacred, the more *mana*-charged is his saliva, and servants follow those of exalted degree with spittoons so that the contents may be buried in some secret place. Among the Masai, no greater compliment can be paid to a person than by spitting in the face. In the Gospels, we are told how spittle was used to cure both the blind, the deaf and the dumb (S. Mark vii, 33-35 and S. John ix, 6). Tacitus records similar miracles worked by the Emperor Vespasian at Alexandria when he touched the blind with his spittle. In Albania and Calabria it is considered proper to spit thrice on a suckling infant and then call out three times "otto nove," that is eighty-nine. This brings luck and may be an echo of the number scheme of Pythagoras. In India, I have constantly seen saliva smeared on the eyes of children and been told that it brings good luck.

The primitive conception of a shadow-soul is responsible for some quaint practices in relation to shadows. Among the Algonkin Indians to tread on a man's shadow is to bring on illness, and in the Celebes, the sorcerer effects this by stabbing a man's shadow with a spear. In my own experience in India, I have known Kabars and others throw away food across which my shadow had passed as a potentially evil influence upon those who chanced to eat that food. In the Solomon Islands, a man avoids places sacred to ghosts when the sun is so placed that it may cast the shadow into them, lest the ghost draw it from the man. This is not far removed from the idea current nearer home that one's fate may be read in the shortening or lengthening of our shadows as we cross the light coming through windows in certain places considered to be haunted. Both Malaysians and Roumanians have a great objection to a man's shadow falling upon a foundation stone during building operations, the belief being that the owner of the shadow will die within the year. On the other hand, the ancient Babylonians and the present Chinese have an idea that though a shadow cannot be buried, it brings luck if the rod or tape used to measure a man's shadow be buried in a building foundation.¹ I wonder whether our present-day practice of depositing coins bearing the sovereign's effigy under foundation stones is a symbolic survival of this old conception and a relic of the days when the foundation stone was an altar sanctified by a primitive rite of laying it in sacrificial blood. There is no doubt that the old English law that a stake must be driven through the body of a suicide was intended to prevent his shadow-soul from walking. In some parts of Germany there survives a curious custom of carrying out the body of a suicide either through a window or by a hole cut specially in a wall, the idea being that it would make it more difficult for the ghost to find his way back. Many primitive races have a rooted objection to photographic portraiture owing to a belief that such records have withdrawn or do withdraw their inner souls from them. Even our own burglars have a reluctance to remove portraits from houses, owing to a latent fear that should

¹ "Encyclop. Biblica—"on foundation sacrifices," pp. 1558 and 2062.

such portraits be of those who are dead, harm or retribution will follow the spoiler.

Like the shadow, so the reflection of man in water or mirror has been associated with magic portents. But a short time back, in a well-to-do family, I heard laments on the breaking of a mirror as certain to bring ill-luck or death. The Andamanese do not regard their shadows but their reflections, in any mirror, as their soul, and the same idea is current in oriental philosophy, as instanced when the Brahman in the Upanishads says, "the person that is in the mirror, on him I meditate." Thus, savage and sage alike regard the reflection as the actual soul. In Peru and Bolivia, the indigenous races strive to keep sorcerers and other evil-doers away by leaving a bowl of water with a knife in it behind the door; the idea being that the villain will flee on seeing his image or likeness transfixed.¹ Even in our own midst, clairvoyants read fate and fortune in mirrors, crystals and in pots of ink. Echoes, to primitive minds, are a confirmation of the nearness of the spirits of the dead. The Anglo-Saxon word for echo is *wudu-maer* or wood-nymph, and in classic myth Echo, as one of the Oreades, was changed by jealous Juno into a love-sick maiden until, pining for love of Narcissus, there remained nothing but her voice. The Sonora Indians believe that the souls of the departed dwell among their mountainous cliffs and that the echoes are their voices. Among the Abipones, the re-echoing of their voices in the Parana forests has the same explanation. Similarly, the Indians in the Rockies will not venture near Manitobah Island because in the low-wailing waves beating on the beach they think they hear voices from the spirit-land.

While to civilized man his name is but a label, to the savage it is an integral part of himself. Hence his reluctance to disclose it to any but intimate relatives, and the building up of many queer customs among primitive peoples in respect of the use or non-use of personal names. Even now, a Hindu woman never mentions her husband's name, but refers to him as "he" or "master" or "father of my child." Our own female rustics use constantly "he" or "my man" in place of mentioning their husband's name. Throughout all grades of culture the giving of names to children is a serious matter and, among primitive peoples, means consultation with the "medicine-man." Among the Maoris of New Zealand, the lustration ceremony includes the recital by a priest or medicine man of a long list of ancestral names and, when the child sneezes, the name then being pronounced is chosen and duly given. In West Africa, among the Yoruba, the name is dictated by the medicine-man who finds out from the gods which ancestor means to dwell in the child and he is called thereby accordingly. The association of name-giving with an event is familiar to us from the Bible. Leah's maid gave birth to a son and he was called Gad because a troop of horsemen came by (Gen. xxx, 11). So, too, Rachel, who dying

¹ "The Evil Eye," p. 83, by F. T. Elworthy.

in childbed, called the babe Ben-oni or son of sorrow, but the father changed it to Ben-jamin or son of the right hand. Among the Chinese, there is always an infantile name or "rice-name" which is never used lest sorcerers hear it and thus be able to work evil spells. The Ainu never give the name of either parent to a child because, when the parents die they are never to be mentioned without tears. In the north of England, a custom prevails of never perpetuating a favourite baptismal name when its first bearer has died prematurely or under disquieting circumstances. In the Middle Ages, no children in many Christian countries were thought to be safe until baptized, because they were things without a name and might be carried off by fairies or witches and a changeling substituted. In Cumberland and Cornwall now, it is common to find a Bible under an infant's pillow to keep away fairies or pixies. The belief in changelings is strong in Ireland and Scotland, where infants are watched carefully till baptized, fishing nets being often spread over the cot to prevent the infant being carried off, and in Sussex and Dorset many villagers think it unlucky to divulge a child's name before baptism. The very use of water in baptism is a link with primitive and barbaric belief in the supernatural efficiency of that medium; water is *mana* alike to medicine-man and priest; it is the same with oil, for does not the name Christus mean anointed? ¹

Closely connected with the association of the occult with name-giving is the use of euphemisms. The desire not to offend and to "let sleeping dogs lie" explains why the Hindu calls Shiva, the god of destruction, the "gracious one," and why a similar euphemism was used by the Greeks when speaking of the Furies as the Eumenides. Even now, the Galway peasant calls the fairies "the others," and a Sligo countryman will refer to the tribes of the goddess Danu as the "royal gentry." In similar way an Arab calls the jinn "the blessed one," and in the Hebrides the devil is referred to as "the great fellow." Names are also changed with the object of confusing or deceiving the believed agents of death or disease. Low caste people in India call the snake "the creeper by night," and a Cherokee of North America refers to a man bitten by a snake as "him scratched by a briar." Kaffirs invariably give the lion complimentary names when there is danger of attack. The Swedes fear to tread on a toad as it may be an enchanted princess and treat it with respect; they also invariably refer as "gold-foot" to a wolf, lest he raid their cattle. In some localities, certain animals are held to be so endowed with *mana* that they are considered to be unlucky and consequently are never mentioned. Thus, on the west coast of Ireland, fishermen never talk of rats but refer to them as "old iron"; an Esthonian fears to mention the hare for fear that his crops of flax should fail. On the Moray Firth, fishermen never mention the salmon, but call it the "beastie." On the Fifeshire coast, the pig is quite *tabu* and

¹ *Journal of Anthropol. Institute*, vol. xviii. "Folk-Lore of the English Counties," by Henderson.

"soo's tail to ye" is a common taunt of a non-fisherman to an outgoing fisher, while to fling a pig's tail into an outgoing boat is to declare war to the knife. If "swine" is anathema to a fisherman on the east coast of Scotland, the word "rabbits" is hated and dreaded equally by a fisherman on the Cornish coast.¹

The world-wide belief in the invisible powers being keen to pounce on mortals explains the Chinese custom of giving a girl's name to a boy in order to deceive the gods, and in India, when several male children have died in a family, it is not uncommon to find very young males dressed as girls to avert further misfortune. In primitive belief both disease and death are due to maleficent agents, hence the common use of euphemisms to avert the evil. In the Scottish Highlands and in India, the small-pox is constantly alluded to as the "good-wife," or as the "mercy of the mother." On similar principles, among the Chinese, when a man dies, the fact may be mentioned variously according to his social status, as either "the mountain has fallen," or that he is "without emolument."² Coffins are called longevity boards, and "boards of old age" or "clothes of old age" are common shop-signs for undertakers in every Chinese city.

Man may soar into the abstract, but he has to live in the concrete and still, to many, to name the invisible is to invoke its presence or the manifestation of its powers. In such matters, civilized and savage are on the same intellectual plane. History and modern custom are full of survivals of the idea. Vague and contradictory as both savage and civilized notions on this matter may be, there is at the bottom a common feeling which prompts to awe and guarded tone when speaking of the dead. This avoidance of the actual proper name of a dead person lives on to our day, because the newly dead become even among ourselves, at least for a time, "He" or "She." The actual name is felt to be too intimate. This being the case in respect of the names of human beings, it is not surprising to find that in respect of names of the lesser hierarchy of spirits and the greater hierarchy of gods, the association of ideas has attained a greater force. The fear of pronouncing the ineffable name of God can be traced to remote antiquity. Whatever may be the attitude of the worshipper, there is belief throughout in the power of the name and in virtues inherent therein. Tradition is powerful and a survey of both the past and present shows how superficial are the changes in human nature and in what small degree the "old Adam" has been cast out. A striking illustration of the belief in the power over a god which mortals may secure by a knowledge of his name is supplied by Plutarch's account of the concealment of the name of the tutelary deity of Rome. Similarly, the pontifices in old Latium endeavoured to conceal the true names of the gods lest they might be used for unauthorized purposes.

¹ "Folk-lore Record," vols. iii. and iv.

² "Strange Stories from a Chinese Studio," vol. i, p. 402-406.

The line between the lower and the higher civilizations is hard to draw in this matter, for even the Quakers of our day, who cannot be accused of excessive ritual, break the silence of their gatherings when the "spirit moves" by invoking the Deity impelled by the feeling that thereby His nearer presence is the more assured. Our Bible is full of passages suggestive of how the Highest is reluctant to reveal His names.¹ The Chaldean legend of how Ishtar was delivered from the underworld goddess Allat, emphasizes the power then believed to pertain by keeping the great name of the god Marduk secret. The Trimurti of the Hindu pantheon have the mystic word *Om* as their symbol, the silent repetition of which is believed to be all-efficacious in giving knowledge of the Supreme. In like manner, among the same people the name of the special deity whom a man worships is kept a secret. To pronounce the name of Confucius is a statutory offence in China. The Marutse of the Zambesi shrink from mentioning the name of their chief god and always refer to him as Molero or "the above." Rabelais tells the story of how Alexander the Great succeeded against Tyre because the secret name of the city was revealed to him. To this day, many Caucasian tribes keep the name of their communal villages secret, from similar motives of a magical power latent therein.

The importance attached to the inter-relationship between the name and the soul was very marked among the ancient Egyptians. They had no doubt whatever that if the name were blotted out, the person ceased to exist, and extraordinary precautions were taken to prevent the extinction of the *ren* or name-soul. The name-soul was inscribed on scarabs, amulets, stones and other talismans. Savage and civilized are at one in identifying the soul with something intangible, such as breath, shadow or reflection, and light is thrown on the point by languages in which favourable circumstances have preserved traces of family likeness and of mutations. In the Aryan group we have a clue in the following interesting words: thus, Gælic *ainm*, Celtic *anu*, old Gothic *ime* and *emnes* all mean "a name." To them may be added our English *name*, the Latin *nomen*, the Sanskrit *namen* and the Greek *onoma*. Compare these with the Gælic *anin*, the Celtic *enaid*, the Latin *anima*, the Welsh *anadl*, the Gothic *anan*, all meaning "soul" or "breath," and we have little difficulty in thinking that the whole Aryan family believed at one time, not only that the name was a part of the man, but that it was that part of him which is termed the soul or breath of life, or whatever we choose to call it.² To clinch the argument, it is curious to note that it is by his breath that the medicine-man among the Amazonian tribes works his cures, that our Bible tells us how Christ, by breathing upon His disciples, imparted to them the Holy Spirit, and that when an ancient Roman lay at the point of death it

¹ Consult Judges xiii. 17, 18, Leviticus xxiv. 16, Exodus xx. 7.

² "Celtic Folk-lore," vol. ii, p. 625; also "Primitive Man," in *Proc. Brit. Acad.*, vol. vii.

was customary for his nearest relative to inhale his last breath to ensure the continuance of the spirit, and that a similar practice in our island is recorded in Lancashire folk-lore. This evidence is but another item witnessing to the psychical, as well as the physical unity of man, and not only to his unity, but to his innate unchangeableness, and how through all stages of belief the formula, *nomina sunt numina*, is operative.¹

But there is no essential difference between names and words; true, the one are associated usually with persons, and the other with things, yet both have been, and even still are by some, regarded as effective for weal or woe by virtue of the control thought to be attainable through knowledge of them. Throughout the ages, the quality of a thing has been credited with an independent personality. The confusion of person and thing meets us very early in man's history, so much so that a suggestion of the deification of speech is not wanting. Tablets of the Babylonian civilization tell of a chaos whence the great gods were evolved, that the word of Marduk shakes the sea, and that at Hermopolis the God Thoth made the world by speaking it into existence. In the same strain from an Egyptian papyrus of the time of Nesi-Amen, we learn that by uttering his own name the great god Neb-u-tcher brought the world into being.² In the Book of Proverbs and the Book of Solomon, the place of "Wisdom" is definite as a co-worker with the Deity, also in the Targums of the Jews "memra" or "the word" is a phrase substituted constantly for the great Name, while under our own dispensation the *Logos* has a definite meaning. The Mangaian islanders of the South Pacific have a myth which tells how the Creator made the land to rise out of the waters, and said aloud to Himself "Good." An echo from a neighbouring hill said "Good." "What," exclaimed the Creator, "is someone here already, and am not I the first?" "I the first," said the echo. Therefore, to those islanders the bodiless Voice is the earliest of all existences, and we find that both the higher and the lower culture held the doctrine of creation out of nothing.³

Since the whole world is made up of living names which concern all substance and everybody, it is not difficult to understand how there arose a belief in the virtue of mystic phrases and a faith in whose efficacy increased *pari passu* with ignorance of their meaning. From this it was but a step to the evolution of *mantrams*, the most typical being the sacred formulas of the Brahmans which are believed to enchain the power of the gods themselves. To the Hindu, the most efficacious mantrum for taking away sins is that called *gayatri*. It is so ancient that the Vedas are held to have been made from it. Only a Brahman has the right to recite it and then only after preparation by profound meditation. Next in importance is the monosyllable *Om* already mentioned.⁴ Allied to mantrams are passwords.

¹ "Lancashire Folk-lore," by Harland and Wilkinson.

² "Egyptian Magic," p. 161, by Wallis Budge.

³ "Myths and Songs of the South Pacific," by W. Gill.

⁴ "Hindu Manners and Customs," vol. i, p. 140 by Abbé Dubois.

We are all familiar with the "Open Sesame" of our youthful readings, but that is nothing to the passwords given in the Book of the Dead used by Egyptians 4,000 B.C. and the oldest known code of private and public morality. Those passwords were needed for the passage of the soul to Amenti or that underworld which led to the fields of the blessed. A further stage in the practical application of the magic influence of words is found in curses. To the ancient Assyrian, the power of the *mansit* or curse was such that the gods themselves could not prevail against it. In our day, the Irish peasant still believes that a curse once uttered must alight on something, while to the Manxman the phrase *mollaght mynneys* is so bitter a curse that it is the besom of destruction. An Arab, when cursed, will lie on the ground so that the curse may fly over him, and a modern peasant of Greece on his death-bed will dissolve salt in water and sprinkle those present, saying, "as the salt dissolves, so may my curses dissolve." In that classic land, curses engraved on leaden tablets have been found by thousands in tombs and temples, and quite a third from Attica contain merely a person's name with a nail driven through it. Tacitus tells us of a similar practice among the Romans. Similar hopes that "as the lead grows cold, so grow he cold," have been found in Yorkshire, and these were not of a remote date. In Moslem countries, the curses of saints and shereefs are specially dreaded. The power of the curse of the aged is familiar to us in the story of Elisha, and the series of curses given in Deut. xxvii. 15, 26, had added force as they were uttered by the caste who spoke as the mouthpiece of Yahwe, and the like applies to many pronouncements of the middle ages. In the list of curses in Deut. xxvii, that on him who removeth his neighbour's landmark is interesting, because it recalls the boundary god Hermes of the Greeks and Terminus of the Romans, also the inscribed boundary stones of the Babylonians which were sacred to the gods Neba and Papu. Even the inanimate and the plant and animal worlds have not escaped the *mana* of the curse word, for both the earth and the serpent were cursed for the sin of Adam.

Oaths are akin to curses in that both are conceived as entities. Throughout the ages in all oath-takings the *mana* of the god's name is the essence. The Persian swore by Mithra, the Greeks by Zeus, the Romans by Jupiter Lapis, the Hebrews by Yahwe, the Moslem by Allah, while the Christian swears on the sacred book by the help of God. Hence the fear of retaliation by the man who breaks his oath because the perjurer has sinned against the god himself and thereby taken his name in vain.

We all are familiar with the account of how the witch of Endor secured the appearance of Samuel by the mere invocation of his name. That witch has her successors in the mediums of to-day to whom the bereaved resort to be put in communication with discarnates who have passed away. Perhaps they do not employ the same complicated processes as used by the witches in Macbeth, or the involved incantations of their forebears of the Middle Ages who summoned the spirits by the holy name Tetra-

grammaton, or by calling the names "Gerson, Anek, Nephrian, Basannah, and Cabou," but the essence of the procedure is the same, and in all cases the effectiveness of the spell is associated with inconsequential acts supplemented by the utterance of names.¹ The witches of to-day are no whit behind their prototypes of Babylon and Chaldæa, for the Sumerian spells have come down to us in the liturgies of that civilization, and throughout them all we can trace the force of the magic conjurations being increased in the degree that they are unintelligible.

It is the same with charms and amulets or things carried. Belief in them as possessing *mana* is universal, and one more link in the long chain which connects the lower and the higher races. Its origin rests on man's abiding impulse to set up theories of connection based on the coincidental and arrestive. The subject covers an enormous field, but the name tablets of the ancient Egyptians and the phylactery of the Jews have their modern counterpart in the scapular of certain Christians and the jade stones, amulets, charms and mascots of indeterminate creeds, whether hung round necks, attached to bracelets and watch chains, or affixed on bonnets of motor cars. In football circles, mascots and charms as luck-bringers are much in evidence. White heather is distributed broadcast, while, at a recent Cup-tie match, the luck of one player was attributed to a piece of coal which he carried with him. Corresponding to these quaint objects are the rolls containing fantastic signs, mixtures of letters and other cabalistic details carried on their persons or fixed to their house lintels by Abyssinians. The sect of the Basilidians among the Gnostics are typical believers in the magic of inscribed amulets or Abraxas stones, so-called from having that word engraved on them, and whose seven letters signify 365, which number is said to indicate that number of spirits emanating from the supreme God. An analogous play with the occult in numbers was the high magical value attached by the ancient Jews to Exod. xiv. 19-21. Each verse contains seventy-two letters, and since one of the mysterious names of God consists also of seventy-two letters, these verses were regarded as representing the ineffable Name. Onomancy or divination from the letters of a name is a very old cult and survives to our day, for I know a man who never thinks of selecting a horse for betting purposes until he has analysed its name in accordance with the numerical and astral value of each letter of which it is composed. Oddly enough, I have reason to know that he finds more winners by his magic method than I do by a study of "Ruff" but, for all that, I cannot but think the new astrology is a vulgar travesty of the old.²

It is common knowledge that all primitive peoples have believed, and do believe that disease and death are the work of evil spirits. Each suc-

¹ "Discoverie of Witchcraft," by Reginald Scot, p. 481. (1886 Reprint of 1584 Edition.)

² "Amulets," by Flinders Petrie; also "On Significance of Numbers," in the *Psychic Gazette*, October, 1917, and May, 1918.

cessive death or illness is regarded as an event wholly by itself, and only to be explained by some supernatural agency. The antiquity of the demon-theory of disease has illustration in the prehistoric practice of trephining skulls so that the disease-bringing spirit might escape; closely related to the same etiological theory is the prevalence of cure-charms. Both Æsculapius and Apollo were surnamed Pæan, after the physician to the Olympian gods, and the songs which celebrate their healing powers were called pæans. In fact, the word *charm* is but a derivative from *carmen*, and meant originally a metrical incantation, for songs are the salve of wounds, as instanced by the songs of healing which the kinsmen of Odysseus sung over him when he was maimed by the tusk of a boar. Italian, German and British folk-medicine is full of inconsequential jingle-charms, notably for ague, toothache, sprains, epilepsy and the evil-eye.

A substitution of names disguises many barbaric word-spells, for medicine remained longer in the empirical stage than any other science; at the same time the repute of the miracles of healing wrought by Christ explain largely the invocation of the Holy Name over both drug and patient not only through the Middle Ages but down nearly to our own time in rural areas. John of Gaddesden, in his "*Rosa Medicinæ*," written in 1314, gives many quaint remedies and charms and prayers for various ills, all more or less associated with invocations to God or the Saints. Horns, as symbolic of the lunar cusps, were a common form of amulet against many ailments, and even now in rural Italy, in default of a horn or some horn-shaped object, the mere utterance of the word *cornea* is held to be an effective talisman. Among orthodox Hindus an indigenous physician, unable to recite the special mantram for the complaint which he is called to treat, has little repute; correspondingly, midwives are called *man-tradaris* because the repeating of efficacious mantrams by them is held to be of great moment to the mother and child. Obviously, it is but a step from listening to the charm-working words of sacred texts to swallowing them, as instanced by the Chinese practice of burning papers upon which charms are written, and mixing the ashes with tea, or the swallowing of written spells given by the Lamas in Thibet as prophylactics, and the Moslem practice in Africa of washing off a verse of the Qûran and then drinking the water.

Such practices may seem very silly, but, after all, are we not with all our vaunted intellectuality doing similar silly things? The multitude drink pints of solutions of various chemical salts or dilutions of various vegetable extracts and tinctures whose virtues for the cure and prevention of various ailments are largely legendary, although commended and given by the modern medicine-man. The same multitude carries bags of camphor, or naphthalene balls, or bottles containing essential oils as amulets and talismans for warding off influenza or other infections; and even rely upon warding off unseen attack from disease by hanging sheets, soaked in lysol, phenol, or eucalyptus, before doors, and sprinkle their floors

and roadways with similar preparations for similar purposes. There are some who scoff at a simple soul burning a taper or candle before a shrine or altar, yet those same people do not hesitate to burn a sulphur candle in a room to exorcise or drive off an unseen enemy as represented by bacilli and other agents of disease. The act of the one is that of a devotee fortified by a fervent faith in a beneficent God; the act of the other is either that of a person too weak morally to proclaim himself a believer in magic, or that of a person too indolent to think and to use the knowledge at his disposal. To trick the faithful into being dutiful Christians is no worse than to encourage a householder to think that infection germs crawl or hop about on floors, walls, ceilings or furniture and to relieve his fears by professing to exorcise the unseen danger with either burning sulphur or by the damping of surfaces with some weak solution applied by a sprayer wielded as a wand of the magician. The difference between the primitive and the civilized is that the former trusted to the *mana* which they associated with the power of a god, while the latter trust to the *mana* inherent to material substances revealed to them by the goddess Scientia and her satellites Bacteriologia and Psychanalysia. These *mana* laden agencies are many and constantly vary in vogue; a few, taken at random, are of such indifferent and varied natures as soda, gentian, quassia, asafoetida, sarsaparilla, taraxacum, tolu, pennyroyal, opsonins, vitamins, antigens, radiant heat, various coloured rays and hypnosuggestion. The awesome and impelling effects aroused by hearing of the attributes of dimethylmethoxyphenol or contemplating the symbol $C_6H_2 (CH_3)_2 (OCH_3) OH$ operate under our dispensation on the same plane as did the enunciation of the power of Tetragrammaton and Abracadabra to a simpler and more primitive civilization. With a similar reliance on *mana* or magic there are others among us who throw a pinch of salt over the left shoulder after having upset the salière at table or, encountering a run of ill-luck at the card-table, rise and turn their chair round three times to change that luck. Truly, for those who live in glass houses it is ever unwise to throw stones.

That superstitious practices should survive still among us need excite no surprise. They are but survivals of our pagan origin. The evolutionist finds an explanation in the arrest of human development by the innate conservativeness aroused when doubt disturbs the settled order of things. Rites survive all dogmas. Like their exponents, they may change their name, but not their nature, and in the ceremonies of civil and religious society we find no inventions but only survivals. Man lived for thousands of years in a very low intellectual environment, and his adaptation thereto was complete. The intrusion of the scientific method disturbed that equilibrium, but, as yet, only within the area of the highest culture. Adaptation, not continuous development, being the keynote of evolution, the superstitions and survivals of the *mana* or magic influence that still operate in so-called civilized communities are no stumbling-block to the

student of history. Man being a unit and not a duality, feeling and thought are in harmony. The exercise of feeling has been active from the beginning of his history, while thought has but recently had free play ; as a creature of emotion, man has an immeasurable past but, as a creature of reason, he is only of yesterday. Indolence, obstinacy and routine are the explanatory causes of the persistence of the primitive, and man's unchanged instincts and passions are the bases of the general conservation of human nature. As Dean Inge puts it, "Apart from the accumulation of knowledge and experience, there is no proof that man has changed much since the first Stone Age." Man felt before he reasoned, and the more unstable his nervous system, the lower is his mentality and the more is he the slave of his emotions, among which the element of fear plays the dominant part. Hence, for superstitions which are the outcome of ignorance, we can feel nothing but pity, because when the correction of knowledge is absent we see that it could not be otherwise. But when knowledge is not absent, the continuance of superstitions or the encouragement of practices with a magical basis is lamentable. The modern medicine-man does not believe in magic, but yet not a little of the routine with which the multitude is treated for disease is irrational unless based on a belief in magic. Unless the medicine-man, urged by his dislike of imposture, strives to make his clients susceptible to the true reasons for rational means of warding off and treating disease, the profession to which he belongs becomes but an exploiter of ignorance and a persecutor of scientific truth, a crime of which other priesthoods have been accused. The lesson of it all is, there is no greater danger than letting things slide or doing and giving just what the multitude desires or expects you to do and give. The attitude of *laissez-faire* may be the orthodoxy of to-day, but, in the long run, it is the most tyrannous and disastrous of all the orthodoxies, since it thwarts honesty and truth.

AND

Royal Army Medical Corps.

The total number of comparative tests made up to the present date amounts to 658, and the results of these tests are recorded in the following table:—

Number of cases	History of cases	Wassermann reaction	Sigma reaction
264	Treated cases of syphilis without clinical symptoms which previously gave a positive Wassermann reaction	—	—
215	Treated and untreated cases with definite history or clinical evidence of syphilis	+	+
4	Treated cases with a definite history of syphilis . . .	—	+
3	" " " "	+	—
172	Observation "cases, i.e., " presented themselves for diagnosis with conditions other than syphilis	—	—

The details of the examinations in these seven cases are as follows:—

CASES YIELDING A POSITIVE WASSERMANN AND NEGATIVE SIGMA REACTION.

				Wassermann reaction	Sigma reaction
October 3, 1921	..	..	1st test	.. —	.. —
„ 14, 1921	..	..	2nd „	.. +	.. —
„ 30, 1921	..	..	3rd „	.. —	.. —

(2) This was a case of necrosis of the jaw suspected to be syphilitic in origin although no definite history of syphilis could be elicited:—

				Wassermann reaction		Sigma reaction
September 10, 1921	..	1st test	..	±	..	—
Provocative dose of arsenobenzol given						
September 19, 1921	..	2nd test	..	±	..	+ (2·7 units)
„ 30, 1921	..	3rd „	..	—	..	—
October 10, 1921	..	4th „	..	—	..	—

(3) A fully treated case of syphilis presenting himself for examination according to the usual routine:—

				Wassermann reaction		Sigma reaction
November 8, 1921	..	1st test	..	—	..	—
„ 22, 1921	..	2nd „	..	±	..	—

CASES YIELDING A NEGATIVE WASSERMANN REACTION AND POSITIVE SIGMA REACTION.

(1) Case admitted on October 29, 1921, with “punched out” indurated penile chancre. Exact date of infection doubtful, but presumed between seven and twenty-one days before admission to hospital. *Spironema pallidum* demonstrated in exudate from sore on October 30, 1921:—

				Wassermann reaction		Sigma reaction
Date of test, October 29, 1921..	—	..	+ (1·4 units)

(2) A well treated case of secondary syphilis:—

				Wassermann reaction		Sigma reaction
September 8, 1921	..	1st test	..	—	..	+ (1·4 units)
October 18, 1921	..	2nd „	..	—	..	+ (1·4 „)

(3) A florid case of secondary syphilis. Both tests agreed at commencement of treatment, but later in history of case Wassermann reaction became negative, whilst Sigma reaction continued positive:—

				Wassermann reaction		Sigma reaction
November 22, 1921	++	..	+ (270 units)
Active treatment						
January 12, 1922	—	..	+ (2·4 „)

(4) A well treated case of secondary syphilis:—

				Wassermann reaction		Sigma reaction
July 25, 1921	—	..	+ (1·4 units)

In the above series of cases it is obvious that the results of both tests are very closely comparable. Discordance has not occurred in the case of serums reacting strongly to one or other test; in such cases the results have been in agreement, but it is in the case of weakly reacting serums that some discrepancy is observed; in these latter cases the balance appears to be slightly in favour of the Sigma reaction.

APPLICATION OF THE TEST IN DISEASES OTHER THAN SYPHILIS.

It has been noted in the table recording results that the serums of 172 cases other than syphilis have been tested with negative result. Several cases of psoriasis and scarlet fever are included in this group; the result in every case was consistently negative.

Opportunity has recently been afforded of testing the serums of six cases of yaws. In all cases the result of the test, as would have been expected, was strongly positive. No clinical details as to the stage of the

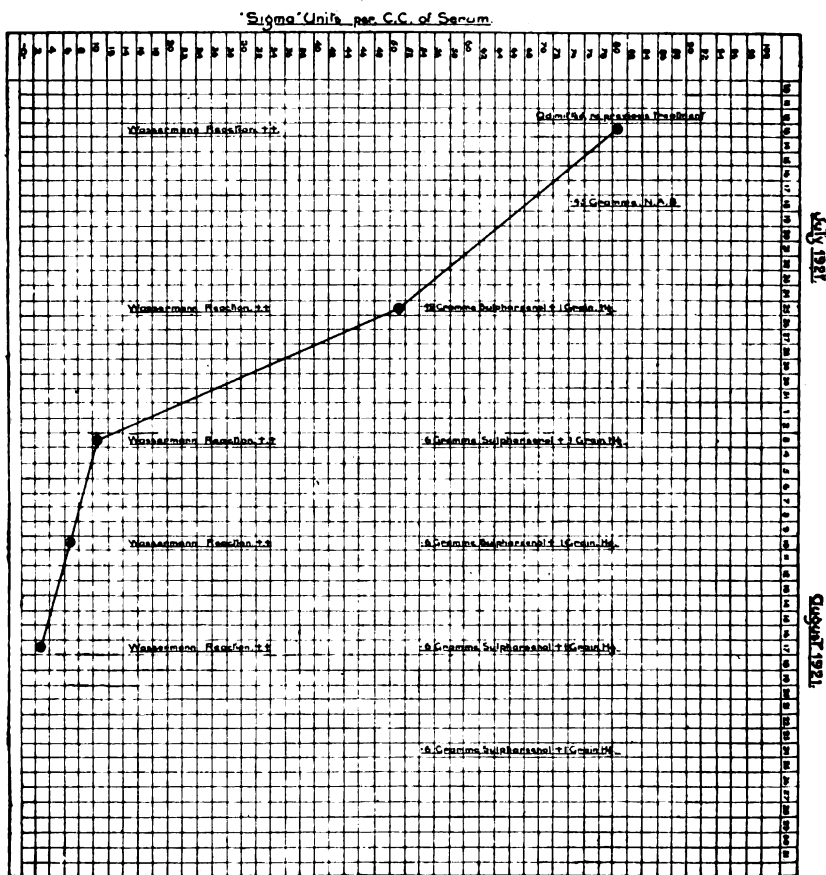
442 *A Comparison of the Sigma and Wassermann Reactions*

disease are available beyond the statement that the serums were obtained from typical cases of the disease. The unit-content of the serum in each case was as follows:—

Case 1	..	..	..	..	..	..	65 units
„ 2	..	..	..	..	..	..	59 „
„ 3	..	..	..	..	..	..	24 „
„ 4	..	..	..	..	..	..	138 „
„ 5	..	..	..	..	..	..	19 „
„ 6	..	..	..	..	..	..	69 „

REPEATED TESTS MADE ON CASES UNDER TREATMENT.

Repeated examinations of a number of cases under active anti-syphilitic treatment have been undertaken with the view of determining the variation in flocculation power of the serum. The graph given below illustrates the primary rapid and later more gradual diminution resulting from efficient treatment. The particular case illustrated was one of secondary syphilis with pustular eruption.



COMPARISON OF THE SIGMA AND WASSERMANN REACTIONS.

Five comparative tests of the Sigma and Wassermann reaction were made, and it will be noted that, whilst the Wassermann reaction was returned as + + on each occasion, the Sigma reaction exhibited an even and regular decline.

These observations have now been made on thirty cases and, in the main, confirm the above results. In addition it was obvious that there was a definite correlation between clinical improvement and diminution in the unit content of the serum.

The following cases illustrate a few examples of these observations :—

Case 1.—A case of congenital syphilis. Clinical sign : interstitial keratitis. Treatment : arsenobenzol and mercurial injections. Clinical condition much improved at termination of treatment :—

				Wassermann reaction		Sigma reaction
September 8, 1921	++	..	136 units
October 10, 1921	++	..	273 „
„ 25, 1921	++	..	372 „
„ 31, 1921	++	..	178 „
November 28, 1921	++	..	2.4 „

Case 2.—Pustular secondary syphilis. Treatment : arsenobenzol and mercurial injections. Rapid improvement and disappearance of clinical signs :—

				Wassermann reaction		Sigma reaction
October 25, 1921	++	..	73.0 units
„ 31, 1921	++	..	8.5 „
November 8, 1921	+	..	10.0 „
„ 22, 1921	+	..	3.0 „
„ 28, 1921	—	..	1.5 „
December 6, 1921	+	..	2.6 „

Case 3.—Case of congenital syphilis. Came under observation suffering from an unhealed gunshot wound of arm. Arsenobenzol and mercurial injections. Condition showed rapid improvement :—

				Wassermann reaction		Sigma reaction
August 19, 1921	++	..	51 units
October 10, 1921	—	..	41 „
„ 18, 1921	++	..	38 „
November 28, 1921	++	..	10 „

Case 4.—Contracted syphilis one year ago and was fully treated. Relapsed with secondary symptoms. Active treatment with arsenobenzol resulting in clinical improvement :—

				Wassermann reaction		Sigma reaction
October 31, 1921	++	..	46 units
November 15, 1921	++	..	46 „
„ 22, 1921	++	..	40 „
„ 28, 1921	++	..	24 „

RESULTS OF OTHER OBSERVERS.

Dreyer and Ward : Out of 1,077 cases examined 63.6 per cent gave a negative reaction by both methods ; out of 386 cases with definite evidence of syphilis the Wassermann reaction gave a positive result in 327 cases, whilst the Sigma reaction gave a positive result in 381 cases.

444 *A Comparison of the Sigma and Wassermann Reactions*

O. Kell: Out of 177 cases examined 59·3 per cent gave a negative reaction by both methods. The results were positive by both tests in sixty-seven cases, whilst in five cases discordant results were observed.

Of these 5 cases, 3 gave a positive sigma test and a negative Wassermann, whereas 2 gave a negative Sigma test and a positive Wassermann.

Rook: This observer divides his cases into three groups and records the following results:—

Group 1.—Cases with known history of syphilis which are either untreated or treated some years previously:—

Total tests	Number agreeing with Wassermann reaction
231	221

Amongst the 10 discordant results 6 occurred in the blood serum and 4 in the cerebro-spinal fluid. In four of the former cases, the Sigma reaction was more in accord with the clinical findings than the Wassermann reaction.

Group 2.—Cases with known history of syphilis which had undergone treatment.

Total tests	Number agreeing with Wassermann reaction
377	302

Of these 75 disagreements the Wassermann reaction was positive in 38 (10 per cent) whilst the Sigma was positive in 37 (9·8 per cent).

Group 3.—Cases in which clinical history was unknown:—

Total tests	Number agreeing with Wassermann reaction
49	45

Of the 4 cases not in agreement, 2 were positive by the Wassermann reaction and 2 were positive by the Sigma reaction.

Assistant Director of Pathology, Northern Command: Seventy-eight cases were examined by both methods. The results were comparable in seventy-four. Of these twenty-three were positive by both tests and fifty-one negative. In the four cases where disagreement occurred the Wassermann reaction was positive and the Sigma reaction negative. One of these cases is stated to have been a tertiary case of syphilis.

In this series no information is available regarding treatment at the time of examination.

Assistant Director of Pathology, Aldershot: Thirty-two cases examined by both tests. In thirty-one both tests were in agreement, whilst in one case the Sigma reaction was definitely positive and the Wassermann reaction negative.

THE PROBLEM OF STAMPING OUT VENEREAL DISEASES.¹

BY LIEUTENANT-COLONEL P. H. HENDERSON, D.S.O.
Royal Army Medical Corps.

As this is a controversial subject I wish to make it quite clear that I am entirely responsible for the views I am about to express. I am not here to present the official views of the Army Medical Services, but propose giving you my own impressions formed from a study of this subject before joining the Service and after approximately twenty-two years' experience in the Army.

It has often struck me as very strange, in view of the widespread tragedies and inefficiency attributable to so called venereal diseases, that scientists and others in responsible positions have not achieved better results, and have not, except in comparatively recent years, devoted more time and energy to the subject.

Many names have become famous through discovering the causes and means of prevention of diseases which are much less important from a national point of view.

The causes of the two principal venereal diseases have been well-known for a number of years, but have we, since that knowledge was gained, advanced as far or as rapidly as we ought to have done in preventing and stamping out these diseases? I most emphatically say that we have not. Why? Largely because those responsible have been afraid to face public opinion and to instil the true facts into the minds of the general public. The general public do not like such truths. They are too delicate to listen to facts relating to this particular subject!

The expression, "give a dog a bad name and it sticks to it," accounts for a great deal.

I submit that the name "venereal" is a bad name for these diseases because it is not a strictly honest definition and it attaches to them a stigma which at once brings a moral aspect into the picture, and it is chiefly owing to the introduction of this latter issue that the difficulties of medical officers of health arise.

You may ask why the name "venereal" is not an honest name. Venereal diseases are defined in Chambers's Dictionary as "diseases pertaining to or arising from sexual intercourse." Is the child who inherits syphilis or who contracts gonorrhœal ophthalmia from the mother suffering from venereal disease? Or, is the woman who acquires syphilis from kissing a syphilitic brother or sweetheart suffering from venereal disease? Certainly not.

¹ Read before the Society of Medical Officers of Health (Navy, Army, and Royal Air Force Branch), on February 8, 1922.

Now, what proportion of so-called venereal patients contract the disease in these and other innocent ways which have nothing to do with sexual intercourse? Twenty-five per cent of all cases of blindness is due to gonorrhœal ophthalmia, most of which is acquired in infancy, and other statistics show that in a large number of cases these diseases are acquired innocently.

I admit that a large number of patients also contract these diseases through sexual intercourse, but are we, whose special duties are connected with the prevention of disease, to sit down with folded arms and do nothing to help those whom spiritual and other advisers have been unable to save? What is more important still, are we, because it entails helping the immoral, to do nothing to save the thousands of innocent children and adults who, through no fault of their own, are exposed to the dangers of these diseases?

Do those people who oppose venereal prophylaxis for so-called moral reasons ever take the trouble to inquire into the number of cases of, say, influenza or diphtheria contracted through illicit and therefore immoral kissing? Certainly not. Yet such kissing is immoral and may be the introductory phase to further immoral acts. Still no stigma attaches to influenza or diphtheria or other non-venereal diseases, such as tuberculosis and scabies, although perhaps acquired in an immoral way, and no bar is ever placed in the way of employing any prophylactic measures considered necessary for their prevention.

I strongly support the clergy who—as their profession demands—tackle this subject from the moral standpoint and who endeavour to do all in their power to persuade people to remain chaste, but I cannot too strongly condemn the fatal policy, adopted by certain people, of allowing such terrible diseases to be spread broadcast merely because this one method of prophylaxis fails to achieve a perfect result.

Moral prophylaxis is after all only one link in a fairly long chain which must encircle these diseases if we are to achieve success.

The argument is frequently put forward that if you endeavour to prevent venereal diseases by means of locally applied medicinal prophylactic measures you thereby encourage immorality and promiscuity because you remove the fear of contracting these diseases.

It is the fear of God and not physical fear which makes a man moral. I would be the last to accuse those responsible for our moral education of slackness, yet in spite of all their endeavours various authorities state that at the present time from eighty to ninety-five per cent of young men indulge in promiscuous illicit intercourse, and a certain vicar in his New Year's message said: "The immorality amongst the young men and women in the parish who do not receive divine grace is simply awful and may be likened to farm yard morality." I do not believe that medicinal prophylaxis properly taught will lower this, already very low, moral standard. On the contrary, I am of opinion that as the incidence of

venereal diseases decreases the moral standard will increase. Even if at first it did induce an extra ten per cent to become promiscuous, this loss would be more than counterbalanced by saving from disease numbers of those who are already promiscuous, and this would further limit the spread of infection.

If we are to deal satisfactorily with this subject we must discard all narrow-mindedness and hypocrisy, and face the cold facts in the full light of our present knowledge of these diseases, and of human nature and the idiosyncrasies to which it is now, always has been, and ever will be prone.

Until the present introduction of venereal clinics and other facilities for diagnosis and treatment under the Public Health (Venereal Diseases), Regulations, 1916, what legislation has been passed since the time of Moses dealing with this all important subject?

The C.D. Acts of 1864 and 1866! I ask you, how could measures of this sort by themselves ever be expected to achieve any marked results? They again should only have been regarded as very small links in the prophylactic chain.

At the present time we appear to have roughly two distinct schools of thought, one which preaches "prophylaxis by early disinfection," and one which advocates "early treatment." I hope no Medical Officer of Health would dream of limiting his endeavours to such narrow limits as those advocated by either school.

"Prevention is better than cure" is a particularly sound proverb to follow with regard to infectious diseases, and particularly with regard to venereal diseases, because of the great difficulty of saying definitely when any case is really cured, and also owing to the very great difficulty in civil life of getting patients to complete their courses of treatment. In civil clinics I understand some fifty-one per cent of patients disappear before the completion of their treatment.

I therefore consider that it is the duty of every Medical Officer of Health to tackle these diseases from the same standpoint as other infectious diseases, viz., prevent them if you can, and if you cannot you must separate the sick from the healthy, and bring the former under the most expert treatment at the earliest possible moment, and keep them under treatment until cured.

I will now give you a sketch of the measures I recommend for dealing with this problem, and will indicate those adopted in the Command in which I am serving, and although I feel that owing to present conditions these measures are not complete, we have reason to be fairly well satisfied with the results so far obtained with our imperfect machinery.

To stamp out so-called venereal diseases, I submit that it is essential to adopt both preventive and curative measures of a most thorough character. I divide my chain of measures into three main links:—

(i) Prevention.

(ii) Notification.

(iii) Treatment and its organization.

I subdivide my preventive link into :—

(A) Educational prophylaxis.

(B) Recreational prophylaxis.

(C) Medicinal prophylaxis.

I further subdivide educational prophylaxis into :—

(1) Moral.

(2) Medical.

(A) EDUCATIONAL PROPHYLAXIS :—

(1) *Moral Prophylaxis*.—Parents, teachers, clergy, and others, must do their utmost to teach chastity and true morality to both sexes, and I sincerely hope that they will be able, in the future, to reap a richer harvest than the four to twenty per cent of young men indicated by the observers to whom I have referred earlier in my remarks. We cannot, of course, control this form of prophylaxis in the Army.

(2) *Medical Prophylaxis*.—This we can and do control, and it forms a most important part of educational propaganda. The medical profession and others working under their guidance should teach prevention from the health point of view by means of lectures, pamphlets, posters, lantern, cinema and other practical demonstrations.

These lectures are given in the Command by the officer in medical charge of effective troops when such officer is capable of lecturing. Where this officer is not capable, the Venereal Specialist, D.A.D.H., or other selected officer, delivers the lectures. The Sample Lecture on prevention of disease issued with War Office No. 24/Gen. No/6398 (A.M.D.2) is given to all lecturers as a guide, and this lecture is modified to suit the special methods adopted in the Command. Combatant officers and non-commissioned officers are also encouraged to have informal talks with their men on this subject.

At depots all recruits are given a short explanatory lecture on the second day after their arrival, when they appear for vaccination; and in other units lectures are at present given monthly.

I am now inclined to think that the troops will take more interest in the lectures if they are delivered once a quarter instead of monthly.

Some of the important points brought out in these lectures are as follows: (1) The only sure means of prevention is absolute chastity. (2) The causes and means by which the diseases are acquired and spread; their dangers, means of prevention, etc. (3) The men are taught not to be shy of reporting sick at once, and the consequences of delay are explained to them, both from the health point of view, and from that of paragraph 462, King's Regulations, where it is laid down that concealment of venereal diseases will be dealt with under Section II of the Army Act, i.e., for disobedience of orders. Every unit must publish an order to this

effect which is read to the unit on parade at intervals not exceeding three months. (4) Men are encouraged to notify their comrades and the medical officer of the name and address of the woman from whom they acquired the infection, and all legitimate means are taken to prevent others contracting the disease from the same source.

(B) RECREATIONAL PROPHYLAXIS.—To this I attach a great deal of importance. Under this heading I include every means of healthy outdoor and indoor recreation which works off excess energy and keeps the youths and men away from all haunts where they are likely to be led into temptation.

On the whole, outdoor games such as football, hockey and cricket are fairly well organized in the Army, although in some stations and units the facilities for enjoying these games are available only to the comparative few who attain a certain standard of efficiency.

In such units and stations the less efficient must either develop into spectators or be tempted away by the less healthy, but perhaps more exciting allurements of the picture house. Cross-country running and other forms of exercise in which all can join are particularly useful in combating this difficulty.

In my opinion enough has not yet been done to make barrack life sufficiently attractive to the troops. During the war many units got up most excellent entertainments in the way of boxing competitions, concerts, folly troupes, pantomimes and indoor games and plays, and the performances were so good that men never got tired of seeing or taking part in them. Much more might be done in this way, and in organizing social evenings in barracks where the men can meet and entertain nice women in decent surroundings.

Another very important factor is the lighting and furnishing of barrack rooms and recreational establishments. In a great many barracks and institutes the artificial lighting has until recently been supplied by gas with plain burners, with a resulting dim religious light in which a man could not read ordinary print in comfort. Until barrack rooms and institutes are efficiently lighted by electric light and the institutes particularly are furnished with a greater degree of comfort, it is asking too much of human nature to expect men to spend their evenings in barracks.

(C) MEDICINAL PROPHYLAXIS.—We all know how easy it is to kill the *Gonococcus* and *Treponema pallidum* by disinfectants.

Acting on this knowledge what are at present known as "Early Treatment" outfits are made available to all men.

These outfits, a specimen of which I circulate for your inspection, are drawn as required from the nearest military hospital and are kept in all barracks on a shelf in what are erroneously termed "Early Treatment" rooms.

Nature of the Outfits.—These consist of a bottle of potassium per-

manganate solution (ten grains to one pint), a collapsible tube of calomel ointment (twenty per cent) and some cotton wool. These are contained in an envelope on which are printed instructions as follows :—

Early treatment and prevention of Venereal Diseases.

Directions for the use of capsule and lotion.

(1) Urinate in gushes, holding the urine back by pinching the foreskin or the mouth of the pipe (urethra) and letting it go with a rush.

(2) Wash thoroughly under the foreskin with the cotton wool, soaked in the solution (contents of the bottle). If the solution is not available use soap and water.

(3) Push a pin through the nozzle of the small tin tube and squeeze half its contents into the pipe (urethra), then squeeze the remaining contents over the knob of the penis, and rub it well in.

If you have delayed the early treatment for some hours ask the *Medical Officer's advice about it.*

Destroy this envelope.

Defects of present outfit.—(1) In my opinion the term “Early Treatment” is *misleading and dangerous*. It is misleading because the outfit is not used for treatment but for prophylaxis and the maximum benefit is derived by applying the calomel ointment *before* sexual connexion and again after washing with potassium permanganate solution *immediately* after connexion. Every moment's delay lessens the chances of prevention, and from observations I had carried out in Transcaucasia and elsewhere it would appear that a delay of four hours renders the application practically useless.

I have always taught the men to take the outfits with them and not to postpone the use of the outfit until they return to barracks, and I encourage men to take a supply with them when proceeding on furlough.

The term “Early Treatment” is *dangerous* because in spite of all lectures a certain proportion of men get the idea into their heads, from the name, that the outfits will cure them if they contract these diseases and consequently they try to treat themselves with the worst possible results.

This may seem strange to some of you, but you must not forget that in spite of the large sums we pay for public education quite a fair proportion of recruits at the present time are illiterate.

(2) *The outfit is much too large and cumbersome* due to the bulkiness of the one-ounce bottle of potassium permanganate solution. The inevitable result is that men do not like to bulge their pockets with the outfit and consequently a certain number neglect to take one away with them, particularly on furlough, with the results which I have already indicated.

(3) The instructions on the envelope are not satisfactory as they do

not teach application of the ointment *before* and *immediately* after connexion.

(4) A pin is not always available for pricking the nozzle of the tube of calomel ointment.

Suggestions for improvement of Early Treatment Outfit.—(1) The outfit should be replaced by a less bulky one contained in a small box made of cardboard, or tin if not too expensive, which will fit comfortably into a waistcoat pocket.

(2) The outfit should consist of:—

(a) A collapsible tube of lubefax (1-1000 oxy-cyanide of Hg.), labelled (1).

(b) A small roll of compressed cotton wool, labelled (2)

(c) A collapsible tube of soft antiseptic soap of suitable strength, labelled (3).

(d) A collapsible tube of calomel ointment of same strength and consistence as the present one, labelled (4).

The collapsible tubes should be fitted with non-screw caps and long nozzles and should not contain a diaphragm which requires pricking with a pin.

I specially advocate the use of lubefax before connexion because it lessens the risk of abrasions of the penis which are so often the site of entry of the *Treponema pallidum*.

Lubefax for this purpose and for use as a disinfectant applied before connexion has the great advantage over an ointment in that it is non-greasy and is easily wiped or washed off. It is also non-irritating.

(3) The outfit box should contain directions for the use of the outfit, pasted on the inside of the lid.

These directions, I suggest, should read as follows:—

Outfit for the prevention of syphilis, gonorrhœa, and soft chancre.

Directions for use.

(i) Before indulging in sexual connexion squeeze a little of the contents of tube (1) into the pipe (urethra) and smear some over and under the knob of the penis and on the outer and inner surface of the foreskin.

(ii) *Immediately after connexion* pass your urine, then get some water and using cotton wool from (2) and soap from tube (3), wash the whole penis, paying special attention to the foreskin, particularly its mouth and inner surface, and the whole of the knob of the penis and all the little crannies round about the bridlesring (bobstay).

(iii) *Immediately after washing the penis*, as described above, squeeze some of the contents of tube (4) into the pipe (urethra) and squeeze some of the remaining contents over the knob of the penis and foreskin and rub it well into every corner.

(iv) Wash your hands carefully with water and a little soap from tube (3).

Venereal Poster.—On this as well as on the outfit envelope the expression "E.T." is used. The poster should therefore be modified as follows: "For E.T. outfit" in line 6 substitute "A prophylactic outfit."

Substitute for the instructions under i, ii, iii, iv, in the present poster the new directions suggested for the inside of the outfit box and add the following additional paragraph as para (v).

(v) If you have not a prophylactic outfit with you proceed at once to the prophylactic room in barracks and get an outfit and carry out the directions detailed in paragraphs 2, 3 and 4 on the outfit box.

If you have delayed more than two hours in carrying out these precautions report to the Medical Officer and ask his advice.

Delete the last three lines on the poster but leave the "note" altering the wording of the "note" to read: "This poster to be displayed only in prophylactic rooms."

Early Treatment Rooms.—In barracks these should be situated in converted w.c. stalls. This position is specially chosen because it ensures privacy as no one suspects the errand on which the man is going.

Some medical officers advocate placing these rooms in medical inspection rooms and guard rooms because they think there is better supervision by a trained orderly in the former, and drunk men can be caught by the guard and led to the latter. The assumption being that a drunk man has probably been led astray sexually as well as alcoholically. I am personally strongly opposed to placing these rooms in either of the latter positions for the reasons I have already stated.

I would strongly recommend those who hold the belief that in most cases venereal diseases are acquired when under the influence of alcohol to study the American figures before and after the introduction of total prohibition.

Internal Arrangements of Early Treatment Rooms.—The seat is removed from the w.c. pan. A tap is arranged over the pan at a convenient height for a man to wash his penis and hands directly under the tap without splashing outside the pan.

Artificial light is provided in the room at night. One or more shelves are provided for outfits and a bucket for soiled cotton wool. A prominent notice is put up directing men not to throw cotton wool into the w.c. pan. The venereal poster is also hung up in the early treatment room.

In some Commands a hot water tank heated by a gas ring is provided and some officers believe in providing a basin, towel, soap and nailbrush for the hands.

I am opposed to all these latter arrangements; if hot water from a central supply could be laid on over the w.c. pan it would be an advantage for those men who are foolish enough to go with a woman without using

an outfit, or who for other reasons have had to delay efficient disinfection till they return to barracks.

If a basin, towel, etc., are provided for the hands, some men are certain to use them for washing their private parts, and this is both objectionable and dangerous.

The position of the early treatment rooms is indicated by means of suitable notice boards.

The term "early treatment room" should be changed to "prophylactic room" as they are in no way intended for treatment.

Charge of Early Treatment Rooms and Arrangements for Supply of Outfits.—These prophylactic rooms should be on charge to the unit and are usually placed under the jurisdiction of the Quartermaster.

The N.C.O. in subcharge varies with local conditions. He is either (a) the N.C.O. of the Regimental Sanitary Detachment; (b) a sanitary orderly of the Command Royal Army Medical Corps Sanitary Detachment; (c) the regimental or medical orderly attached to the officer in medical charge of the unit.

Outfits in bulk are kept and partly made up at the nearest military hospital, and are supplied to the early treatment rooms as required, on indent.

The officer in medical charge of the unit supervises the arrangements in the early treatment rooms.

Rendering of Returns.—The Officers Commanding military hospitals render the venereal returns to their respective Assistant Directors of Medical Services and the D.A.D.H. compiles the area returns.

Duties of a D.A.D.H. in Connexion with the Prevention of Venereal Diseases.—He should not as a routine measure give the ordinary educational lectures referred to earlier, but if the incidence of venereal diseases remains high in any station and in other exceptional circumstances, he does give special lectures to the troops.

He, under the Assistant Directors of Medical Services of Areas, exercises supervision over anti-venereal measures, particularly with regard to the following points:—

(a) Investigation of the source of any unusual incidence and indicates the measures necessary to deal with it.

(b) Position and number of so-called early treatment rooms in each unit in his area.

(c) Artificial lighting of these rooms.

(d) Supply of outfits and fixtures for these rooms.

(e) Cleanliness.

(f) Frequent discussion with Officers and N.C.O.s, locally concerned, the various points connected with the organization and execution of anti-venereal measures.

(g) Compilation of the venereal returns for his area and keeps up area graphs, charts and statistics.

Duties of an A.D.H. in Connexion with Venereal Diseases.—(a) Generally works out and organizes the various arrangements for combating venereal diseases in the Command.

(b) Compiles the Command venereal returns and statistics and keeps up the Command venereal charts and graphs.

(c) Acts as the technical adviser of the Deputy Director of Medical Services.

II.—NOTIFICATION.

In my opinion some form of private notification should be introduced, and I suggest something on the following lines:—

Every person suffering from a venereal disease must report sick to a qualified medical man and submit to treatment. Such person must abstain from marriage or sexual connexion until the qualified medical man responsible for the treatment gives her or him a certificate to the effect that she or he is cured.

Should any person give venereal disease to another through sexual connexion or kissing, such person should be liable to severe punishment and, if necessary, be confined in hospital till cured. If it could be proved that the person who conveyed the infection was ignorant that he or she was suffering from the disease, the individual could get the benefit of the First Offenders Act.

In the Army at present we have what amounts to a very strict notification, as all men are examined weekly or monthly, not specially for venereal disease, but such diseases would be observed at these health inspections. Further, if a soldier contracts a venereal disease and does not report sick he is liable to punishment under Section II of the Army Act for disobedience of orders.

III.—TREATMENT OF VENEREAL DISEASES.

The final link in the chain is the treatment and its organization.

In certain general hospitals special venereal centres should be set apart for the treatment of venereal disease.

I do not advocate special venereal hospitals in which no other class of patients is treated, as anyone who has experienced the administration of these hospitals knows the great difficulty of maintaining discipline and of running these hospitals satisfactorily. This is again due to the horrible stigma attached to such places and the want of self-respect which such conditions engender amongst the patients.

Venereal cases should never be treated in hospitals which have not got special venereal wards with all the necessary facilities for up-to-date treatment. The ideal conditions are special wards or departments of a general hospital with, of course, special dining rooms, lavatories, etc. One such venereal centre should usually be provided in each administrative area, and the patients should only be treated by experts assisted by specially trained orderlies.

The Command Venereal Specialist should supervise and standardize the

venereal treatment in the various centres in the Command, and should satisfy himself that everything is satisfactory in the way of treatment and that no venereal patient is given a clean bill of health or escapes treatment until he is cured.

I mention these rules regarding treatment because I feel sure you will agree that in tackling this problem you cannot divorce prophylaxis from treatment. I would also like to emphasize the importance of bringing all patients under expert treatment at the earliest possible moment. The sooner a patient is brought under treatment the better his chances of a rapid and complete cure. If the educational propaganda are satisfactory you will get more cases in time for the abortive treatment of gonorrhœa and you will get syphilis cases in the very early primary stages.

Abortive treatment should not, in my opinion, be carried out in barracks or local hospitals but in the venereal centres.

This completes the measures which I recommend for dealing with the venereal disease problem.

Statistics.—I will now give you a few statistics bearing on the results obtained in the Command with our present methods, which include: (1) educational prophylaxis in the form of lectures and demonstrations by medical officers, etc.; (2) medicinal prophylaxis as already described; (3) recreational prophylaxis (incomplete); (4) notification as described above; and (5) early and complete treatment by experts. I think you will agree that the figures, for the accuracy for which I can vouch, give one cause for optimism, and it is my opinion that if the problem was tackled in the fuller and common sense lines I have indicated in this address, in the civil population, venereal diseases instead of being perhaps the greatest scourge to our race would soon become as rare as smallpox.

I would impress on you the fact that the results obtained have been arrived at in spite of conditions which were really adverse to us, viz., we were dealing with men who were younger than the average pre-war soldier. Many were badly educated and difficult to teach, and they had more money and were better fed. We have no control over the infected civilians from whom the troops acquire infection.

I regret that in former years the Army was looked upon as the great male spreading cause of venereal diseases. I submit that this stigma can no longer be cast up against it and that in fact, taken as a community, they are the only class, perhaps with the exception of the Royal Navy and Royal Air Force, from which it is practically impossible to contract venereal diseases.

RATIOS PER 1,000 OF STRENGTH.

			U.K.		R.C.
1913	..	..	50·9	..	45·0
1914	..	..	51·8	..	55·5
1920	..	..	48·3	..	41·1 (contracted with unit in Command 22·6)
1921	..	..	40·8	..	28·4 (" " " 16·5)

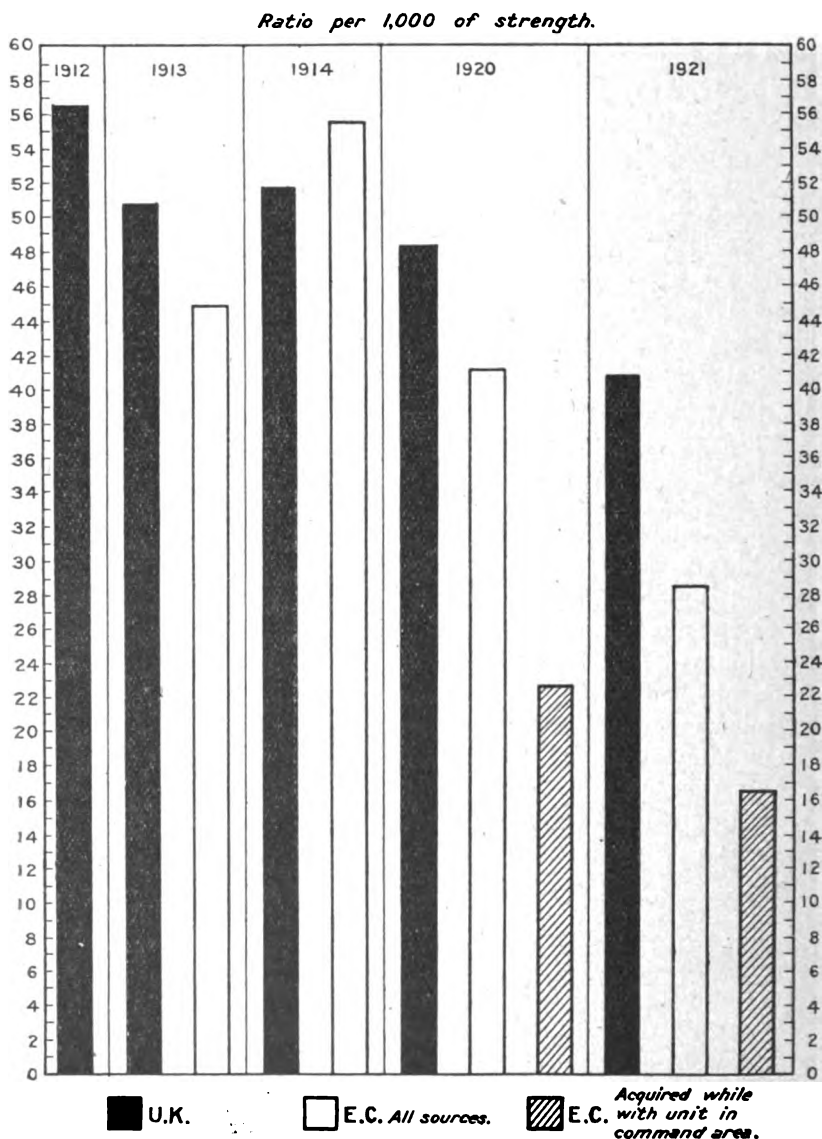
The figures 22·6 and 16·5 are the true figures, as in the other cases the diseases were contracted by recruits *before joining or by troops abroad or in other Commands.*

STATISTICS AS TO MEDICINAL PROPHYLAXIS.

			Outfit used under four hours		Over four hours		Not used
Gonorrhœa	..	..	75	..	39	..	141
Syphilis	..	..	13	..	4	..	36
Soft chancre	..	..	14	..	5	..	15
Totals	..	..	102	..	48	..	192

Annual ratio per 1,000 men of outfits used : 1,166.

GRAPH SHOWING THE INCIDENCE OF VENEREAL DISEASES AMONG TROOPS IN THE UNITED KINGDOM, AND IN THE EASTERN COMMAND.



Royal Commission on Venereal Diseases.—Ten per cent of population of large towns have syphilis, over ten per cent of population of large towns have gonorrhœa. This report does not give figures for soft chancre.

In Baku all patients were interrogated as to the time that had elapsed between connexion and the use of the outfit. The evidence thus obtained, although open to certain fallacies, clearly indicated that the proper use of the outfit within two hours after connexion undoubtedly reduced the incidence of venereal diseases. Where the use of the outfits had been delayed over two hours very little if any benefit appeared to be derived from them.

In Transcaucasia I converted one field ambulance into a venereal hospital. Prior to this the personnel of the unit suffered equally with other units from venereal diseases. The educational effect of acting as a venereal diseases hospital so impressed the Royal Army Medical Corps personnel that from within a few weeks of acting as a venereal diseases hospital no single case of venereal disease occurred amongst the personnel. I was able to obtain definite evidence from the N.C.O.s and men that there was no diminution in illicit connexion, but that the men took the greatest care in using the prophylactic outfits. They instanced cases where men who had gone out without outfits and indulged in illicit connexion, were known to run back to their unit in order to use the outfit in time.

If we take these last statistics in combination with those I have just given you on the results of medicinal prophylaxis, they throw considerable light on the benefits of early disinfection.

There are the obvious fallacies: (a) we have only the statements of the men to rely on as to the use of the outfit, and many men are apt to say what they think you want them to say; (b) we do not know how many of the women were diseased; (c) we do not know how many men escaped disease although taking no precautions.

However, if we assume that a very large number of men who go with diseased women and who do not take precautions *must* contract the disease, and if we take it for granted that the Royal Commission's figures would be higher amongst women who, whether as amateurs or professionals, indulge this hobby, then we have in our statistics at least the large majority of soldiers who have had connexion with *diseased* women and who have not taken precautions.

These figures are therefore a fair indication of the benefits of prophylaxis by early disinfection.

I wish to thank Major-General A. P. Blenkinsop, C.B., C.M.G., D.D.M.S., Eastern Command, for permitting me to publish particulars of the methods adopted to meet this problem in the Eastern Command; and the Navy, Army and Royal Air Force Branch of the Society of Medical Officers of Health for permitting me to publish my paper.

Clinical and other Notes.

NOTES ON A CASE OF MYIASIS.

By MAJOR W. F. M. LOUGHNAN, M.C.

Royal Army Medical Corps.

A PATIENT stationed in Belize, British Honduras, first complained of itching about both ankles. He localized the discomfort to a point immediately posterior to the tips of the external malleoli, almost in the same position in each foot and occupying an area of about two centimetres. Five days later both ankles became inflamed and swollen. The painful condition he compared to a red-hot needle being pushed into the skin behind the external malleolus, at intervals of two or three hours.

He was first treated with hot fomentations which gave him no relief. He then consulted a "local doctor" who pronounced the inflammation to be a myiasis due to the larvæ of the *Dermatobia cyaniventris* fly (Macquart), and treated the infected parts by gumming a tobacco leaf over them, which caused almost immediate cessation of the pain. This application was allowed to remain *in situ* for eight hours, after which the painful parts were squeezed, and a larva expelled from each inflamed region. The larva of this species of fly is found infecting man and animals in tropical America, and is known by different local names, notably: "ver moyoquil" in Mexico; "ver macaque" in Cayenne; "torul" in Venezuela; "una" and "berne" in Brazil; "cormollote" and "anal coshal" in Demerara.

According to some authorities the *D. cyaniventris* fly is supposed to lay its eggs on the skin of man and domestic animals, the eggs, rapidly passing to the larval stage, and penetrating the skin, causing much pain and ulceration.

Blanchard, Surcouf, and Zepeda, have shown the peculiar way this myiasis is produced. The *D. cyaniventris* fly lays its eggs on damp leaves, or in wet places where the *janthiosoma* mosquito is to be found.

The eggs are laid in collections which are enclosed in membrane-like cases. This cement-like membrane, which forms the coverings of the egg collections, becomes softened by moisture and adheres to the mosquito's thorax; the eggs are thus carried to the integument of man or animals, whose blood is acceptable to this species of mosquito. The eggs of *D. cyaniventris* having been deposited on the skin, pass to the larval stage, penetrate the superficial tissues, causing pain, swelling and ulceration.

REFERENCE.

CASTELLANI and CHALMERS. "Manual of Tropical Medicine," Second Edition.

ENTOMOLOGICAL NOTES.

BY MAJOR J. E. M. BOYD, F.E.S.

Royal Army Medical Corps.

ON THE INCIDENCE OF MITES ON MOSQUITOES.

It has been noticed that many mosquitoes, when caught, are infested with some species of parasite, females being usually more infested than males. Several of these infested mosquitoes have been kept under observation, in order to find out if possible, whether they suffered any ill-effects from the presence of these parasites; how the parasites became attached to the mosquito, and finally the life history of the parasite.

Some of the infested mosquitoes were kept alive in a breeding cage—these did not apparently suffer any material damage and oviposited normally. It was not possible to prove whether the life of the mosquito was shortened, when infested, but this appeared to be the case, as uninfested mosquitoes caught at the same time, certainly lived slightly longer—but there was nothing to show that they had not emerged from the pupal stage at a later date than the others. The constant drain on the body juices, occasioned by the presence of parasites, must have some effect on their health.

That these are actual parasites and not merely "passengers" was proved at the War Office Entomological Laboratory, some time ago, by Major Langrishe, D.S.O., R.A.M.C., who cut sections of an infested mosquito which showed the proboscis of the parasite piercing the body wall of the mosquito.

On separating some of the parasites from a mosquito, it was found that they were the larval stage of some species of mite.

The site of attachment is invariably on the abdomen of the mosquito; not one has been found by the writer on the head or thorax, nor have they ever been noticed by him on the larvæ or pupæ, though Colonel Alcock, C.I.E., in his book "Entomology for Medical Officers" states that they are found on the larvæ.

The largest number of these larval mites found on a mosquito was 33, on a female, others carried as many as 27, 24, 21 or less. In every case the infested mosquito was an *Anopheles maculipennis*—they were not found on *A. bifurcatus*—*Culex pipiens*, or *Theobaldia annulata*. This may be accounted for, however, by the fact that *A. maculipennis* was the species most usually collected in farms and cowsheds, though the other species were also taken in fair numbers.

The next thing to be worked out was how these larval mites became attached to their hosts. Were they terrestrial or aquatic? It was at first thought that perhaps the larval stages might be terrestrial and became attached to the mosquito in its resting place—in support of this view was the fact that the mosquito takes so short a time to emerge from its pupal case, that it is almost incredible that as many as thirty-three of these larvæ can attach themselves in the short period, but a careful examination of the larvæ proved them to be some species of hydrachnidæ (water mites).

Attempts were made to drown the larvæ without success, the mosquitoes were, however, easily drowned, the larval mites leaving the dead bodies almost

at once: kept in water containing weed, these mites moulted within a few days, but no evidence could be found of their breeding, under laboratory conditions.

Water taken from the dykes near which the mosquitoes were found, failed to show the presence of any of the mites—although they must have been present in considerable numbers.

That the incidence of these larval mites is seasonal may be seen from the following table, which gives the number of mosquitoes examined and other details:—

Month	Number of mosquitoes examined			Number infested			Total number of larval mites
	M.	F.		M.	F.		
July	49	950	..	3	51	..	392
August	76	957	..	1	15	..	74
September ..	106	1,032	..	0	3	..	18
October	43	781	..	0	1	..	2
November ..	8	250	..	0	0	..	0
Total	277	3,970		4	70		486

The subject is of considerable interest and perhaps some members of the Corps, stationed abroad, where infested mosquitoes are not uncommon, may be able to throw further light on the matter.

A METHOD OF MEMORIZING A MAP.

By MAJOR A. C. H. GRAY, O.B.E.

Royal Army Medical Corps.

IN Karlsruhe Gefangenen-Lager, there was a map—a very very secret document which was handed round by stealth. It showed the way to Switzerland and home, and was the property of an officer of the Royal Air Force. In course of time it came my way.

Now our captors were fond of making sudden and surprising searchings, and a secret map was not a thing to keep about one's person. To evolve a method of committing that map to memory gave me, and doubtless many others, food for thought. There was plenty of time to think in Karlsruhe Gefangenen-Lager.

Eventually I hit upon a method of fixing in my mind some of the salient features of this map, and in case that method may be of use to others, I will try and describe it. I cannot claim much originality for the method itself, but there may be something new in its application.

A map of the country between Karlsruhe and Switzerland is no longer of such particular interest, but it may be that some may wish to fix in their minds other maps—that of the war area as a whole in Northern France and Belgium for instance.

If you can, by any method, fix certain places or features so that they can at any time be reproduced in their exact relative position to one another, you have the skeleton of a map and something definite to work on. The more places you can fix the better, but even a few are helpful.

As an illustration, take a small scale map of Northern France and Belgium (of

about forty miles to the inch) and choose some central spot—say Peronne on the Somme. With Peronne as centre and with radius Peronne—Ostend, describe a circle. Mark on the circle the sixteen points of the compass, N., N.N.E., N.E., and so on all the way round. Now if you have chosen well, some of these points will correspond more or less accurately with well known towns or other important feature, such as points on the coast or important rivers. To reproduce these particular towns or features in their exact relation to one another, is then quite easy and needs no great effort of memory. Take a piece of paper, draw a circle on it, mark the circumference with the principal points of the compass and draw radii from the centre to them. Where these compass points correspond or nearly correspond with some important town or other feature, mark that down on the paper.

In the case of Northern France and Belgium, the circle drawn as described will give the following :—

Centre	..	..	..	Peronne and River Somme.
N.	..	..	..	Ostend.
N.N.E.	..	..	..	Ghent.
N.E.	..	..	..	Brussels.
E.N.E.	..	..	..	Namur and junction of Sambre and Meuse
E.S.E.	..	..	..	Vouziers and the Aisne.
S.E.	..	..	..	Chalons-sur-Marne.
S.S.E.	..	..	..	Sezanne and the Grd. Morin.
S.	..	..	..	Rozoy.
S.S.W.	..	..	..	Close to Paris.
S.W.	..	..	..	River Seine.
W.S.W.	..	..	..	Rouen and the Seine.
W.	..	..	..	Dieppe and the Coast.
N.W.	..	..	..	Cape Griz-nez.

in fact fourteen important places and seven rivers. All these places do not exactly correspond with the compass points, but the majority do, and the others are near enough for a rough map.

Having got the above, other points can be readily obtained by joining the N.W.—N.E.—S.E.—S.W. points on the circumference to one another. The sides of the square thus formed where they cut the radii of the circle, give :—

N.	..	..	..	Ypres.
S.	..	..	..	Lizy on the Marne and the River Ourcq.

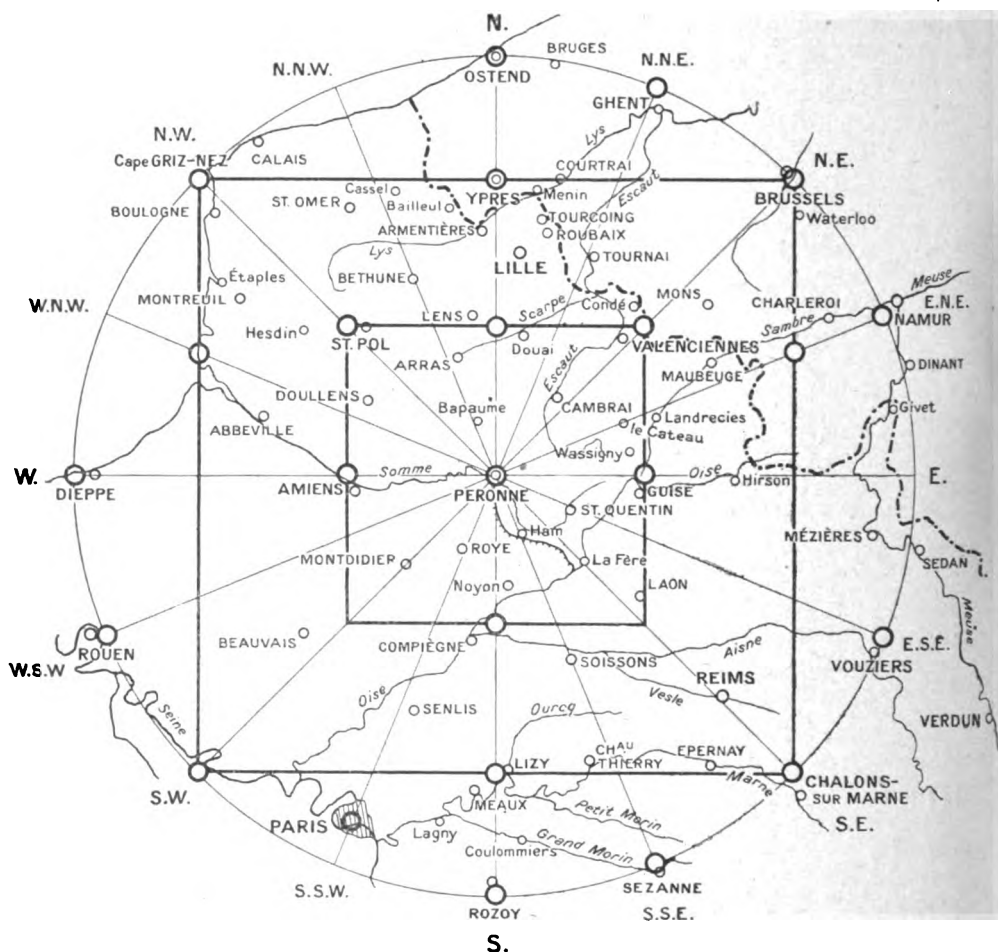
the West side of the square gives the line of the coast from Griz-nez to the mouth of the Somme; the East side cuts radii at the river Sambre and at the Belgian frontier.

Other points can be fixed by drawing a smaller square inside the first, joining the bisections of these same four radii. You thus obtain St. Pol, Valenciennes, Amiens and Guise, and points on the rivers Escaut, Somme and Oise.

You have thus fixed definitely in their relation to one another thirty important places, &c., and the skeleton of the map is complete.

The accompanying sketch-map will perhaps make the above description clearer. The radius of the circle is about ninety miles in length and gives the scale.

I am indebted to Messrs. Constable and Co., Ltd., for kindly allowing me to make the sketch-map from a map in their possession.



THE INTERNATIONAL CONGRESS OF MILITARY MEDICINE AND PHARMACY.

By MAJOR A. D. STIRLING, D.S.O.
Royal Army Medical Corps.

THE following notes on the First International Congress of Military Medicine and Pharmacy have been extracted from the Official Report, and will, doubtless, be of interest to officers of the Corps.

The first International Congress of Military Medicine and Pharmacy, which was organized by the Belgian Medical Service, was held at Brussels last July, and it was decided to hold similar assemblies every two or three years.

To the first Congress representatives of the Medical Services of all allied and neutral powers were invited, and, as a result, besides a large number of repre-

representatives who attended in a private capacity, delegations were sent by the following countries and societies :—

Argentine Republic.	Japan.
Brazil.	Mexico.
Britain.	Morocco.
Chili.	Norway.
China.	Poland.
Czecho-Slovakia.	Spain.
Denmark.	Sweden.
France.	Switzerland.
Guatemala.	United States of America.
Holland.	The International Red Cross Committee.
Italy.	The League of Red Cross Societies.

The Congress, which proved a great success, was held under the patronage of His Majesty the King of the Belgians, who was present at the opening meeting and received the principal delegates.

The main object was to profit from the lessons learned during the Great War, and the following subjects were discussed :—

- (i) The Clinical and Therapeutic Study of War Gases.
- (ii) The Campaign against Tuberculosis in the Army.
- (iii) The Campaign against Venereal Disease in the Army.
- (iv) The General Organization of the Army Medical Service.
- (v) The Lessons of the War in the Treatment of Fractures of the Limbs.
- (vi) Water Purification in the Field.

At the final session of the Congress certain resolutions were unanimously approved. These are literally translated as follows :—

(1) The International Congress of Military Medicine and Pharmacy has obtained results which justify great hope for the future.

At a certain period of life, towards the age of 20, in every country, young men, including the best of the race, come under the care of the Military Medical Service.

It is easy to imagine how important a part the latter can play in the health of the race; it is not too much to say that from the point of view of eugenics it has a world-wide rôle.

(2) This world-wide rôle cannot be played to the full on account of dispersion of effort. There exists in military medicine a live force which must be centralized, and it is only by official organization of military medicine in every country that measures can be instituted which would be certain of application, and thoroughly supervised.

(3) The periodic reunion of a Congress of Military Medicine and Pharmacy would permit of the realization of this object, and the whole human race would profit from the advances made by one or other of the nations.

It would maintain effectively the association established by this Congress between military doctors and pharmacists.

It is to be understood that the same rules which were in force at the Brussels Congress will apply to future Congresses.

(4) It is also desirable that an International Association of Military Medicine and Pharmacy should be formed under the same conditions.

(5) With this object in view a Permanent Committee has been elected by the Brussels Congress. It is designed to centralize all the results obtained, and is charged with the arrangements for the next Congress.

The Committee is composed as follows :—

President.

Lieutenant-Général Wibin, Inspector-General of the Belgian Army Medical Service.

Members.

Médecin principal de 2e classe Uzac (France).

Commandant A. Van Baumberghen (Spain).

Surgeon Commander W. S. Bainbridge (U.S. Naval Reserve).

Major A. D. Stirling, D.S.O. (Great Britain).

Lieutenant Colonel F. Caccia (Italy).

Lieutenant Pharmacien De Fonseca (Brazil).

Lieutenant Colonel Thomann, Pharmacien-en-chef (Switzerland).

Médecin Major 2e classe Voncken (Belgium), *Secretary.*

At a meeting of the Permanent Committee held recently in Brussels, it was decided to hold the next Congress at Rome during the spring of 1923, and the following questions were drawn up :—

(1) *Evacuation.*

(i) General principles of evacuation from the armies in the field.

(ii) Organization of evacuation, bearing in mind the limitations imposed by the condition of the patients.

(iii) Adaptation of medical and surgical methods of treatment in accordance with the varying conditions imposed by the necessity of evacuation.

(2) Collaboration between the competent civil and military authorities in questions of social hygiene, physical training and prevention of disease.

(a) Statistical consideration of disease—tuberculosis, venereal disease, alcoholism, mental defects—the sorting out of such cases, and measures of prevention.

(b) Vaccination and protective inoculation.

(3) A critical study of the methods of disinfection and disinfestation in both peace and war.

(4) The treatment of penetrating wounds of the chest and of their sequelæ.

(5) *Pharmacy.*—Chemical laboratories in the field, their rôle and the methods employed.

Two reports to be given on each subject as follows :—

Q. (1) By Italy and by France.

Q. (2) By Italy and by Britain and America (conjointly).

Q. (3) By Italy and by Spain and Switzerland (conjointly).

Q. (4) By Italy and by Serbia.

Q. (5) By Italy and by Czecho-Slovakia.

The *Archives Médicales Belges* has been adopted as the official journal of the Association, and officers of the Royal Army Medical Corps are invited to send contributions to that journal. These will be published in the language of the author.

Echoes of the Past.

A VISIT TO THE ROMAN WALL.

BY COLONEL S. F. CLARK.

OUR country is full of relics of the past, each of them with its own peculiar interest, whether it be the work of Ancient Briton, of Saxon, or of Norman, but for richness of romance not one of them surpasses the Roman Wall near the Scottish border. Our pride of Empire is jolted as we look at this witness, on our own ground, of the former absorption of our England in another empire, and our imagination is stirred by the sight of the actual line where that dominion ended.

We are accustomed to find a country bounded by one of the works of Nature—a sea, a river, or a mountain range—but here is a man-made barrier in our own land, ordered by an Emperor to mark the chosen limit of his sway.

And his empire has crumbled like his wall, whose ruins remain to us as a reminder and a warning.

In the hope that this effort may send some of our corps to view this ancient rampart, I give an outline of its history and a short account of what I saw of it.

Julius Cæsar landed in Britain in 55 B.C., but it took the Romans about 135 years to subdue the country. When this had been done, about A.D. 80, Agricola fortified a line from the Forth to the Clyde, but he soon abandoned it and returned to Rome. Forty years afterwards the Britons in the north rose in revolt and destroyed the Ninth Legion at York, which brought the Emperor Hadrian on the scene in person, with the newly arrived Sixth Legion, and after restoring order he built a turf wall across England from the Solway to the coast of Northumberland, and declared that no further conquest should be made. After his death, however, Lollius Urbicus, a Roman general, pushed up again to Agricola's old line and built a wall of sods along it, which is still referred to as Agricola's wall. The two ramparts existed together for forty-five years, but in A.D. 185 the Romans were compelled to fall back to the Cheviot hills. They made no move for over twenty years, but about A.D. 208 the Emperor Severus took matters in hand and invaded Caledonia, but decided to make Hadrian's barrier his substantive frontier. It is apparent that this was a much stronger position than Agricola's, and Severus replaced the turf wall by one of stone, dug a deep ditch in front of it, and built forts, towers, and blockhouses at intervals. With a strong force of Roman soldiers behind it this wall was impervious to all attacks, and, until the Romans withdrew from England two hundred years later, it remained the "sure shield" of Rome's western flank. The successors of Severus made no

attempt to go beyond it, but they strengthened the wall and kept it amply garrisoned, so that the Scots were unable to gratify their national instinct to get into England, which exists even unto this day.

This article was begun in the summer of 1914, but it had to be put aside until a more convenient time. In June of that year a week-end duty took me to Carlisle, and I eagerly seized the chance of using the free Sunday in satisfying a long cherished desire to see the Roman Wall, so I went by train on the Saturday evening to the Orchard House Hotel at Gillsland.

Next morning I walked about two miles west to Birdoswald or Amboglanna, one of only three existing camps or large stations, each of which is thought to have held 12,000 men. Its outlines can be easily traced by the mounts which mark its boundaries, and a guard room still exists on each side of one of the gates, but what I really appreciated were the grooves worn on the sill stone of the opening by the wheels of chariots and other vehicles. They were as clear as if they had been made yesterday, while there was no mistaking the holes in the stone in which the pivots of the gate had swung.

Refreshed by Sunday's midday dinner at the hotel, I took an afternoon train to Haltwhistle, as the map showed a line of wall about three miles north of that place. After leaving the train I made for three crags which I was told were at the wall, but it was heavy going, over fields and fences on to moorland, with long wet grass and swampy patches, always up hill, while an unseasonably cold, searching wind blew strongly over the moor, driving before it drenching showers of rain which fell at intervals.

At last I reached the crags, and all my toil was forgotten as I saw before me a low, narrow mound winding its way both east and west, which I gazed at with the utmost interest. Was this the boundary of the empire of ancient Rome? Yes, at one spot in the mound the earth had been scraped away, laying bare a cut grey stone—undoubtedly it was the Roman Wall.

To the east was a long stretch of precipitous crags—itsself a first-rate defence—and as one saw how the wall ran along the top of tense steep rocks, one recognized why this area had been included in the fortified frontier. Against the weapons of 1,700 years ago the commander of this section of the rampart had an easy billet.

I should have liked to have gone east, but time pressed, so I walked in the opposite direction on the top of the wall, which was merely a continuous narrow ridge of earth about four feet high, with, apparently, a stone centre. A dressed stone at times peeped out of the face of the ridge, and at one place a blockhouse had been restored, but it was easy to see that the countryside had looked upon the wall as a heaven-sent quarry of prepared stones for the building of their farmhouses and of their field boundaries. It is surprising that any stones at all are left in place, but presently, amid a growth of small trees, ferns, and wild flowers, the ridge

became a wall again, and I counted nine courses of stone above ground, all in position as the builders had left them. I believe that this is as good a piece of the wall as can be seen anywhere: there is not much of it, and small trees have rooted themselves in it and damaged it, but there it is, without doubt, a wall. The stones were all of a grey colour, shaped very like bricks, but rather larger, and each one had been carefully squared and dressed, and well and truly laid. It was evident that the wall had been no jerry-built affair, but was erected with skill and craftsmanship.

This fragment doubtless owed its immunity from removal to its remoteness. It stood in a bleak and desolate spot on the moors, not a human being was in sight, and the cries of the curlews and peewits added to the wildness of the scene. I peered over the top of the wall and thought of the countless Roman soldiers who had done the same thing, and who had seen the Solway gleaming in the west as I saw it, and the moor stretching endlessly to the north and to the east. As the cold wind blew through me on that summer day, I could imagine what keeping watch there in mid-winter must have meant to the Roman sentry, and how he must have longed for the soft breezes of his own country, and must have cursed the fate that had brought him to this inhospitable spot.

Further to the west the ridge ended abruptly at a modern quarry, but in a field beyond was a fine piece of the ditch which Severus had dug in front of the wall. It ran down hill in a perfectly straight line to Thirlwall Castle, which is said to mark the spot at which the Scots broke through the abandoned defences after the withdrawal of the Romans. This castle was so unashamedly built of the stones of the wall, that it is not surprising that all signs of the barrier were lost at this point.

The village of Greenhead was not far off, and after a much needed visit to the inn there, I walked back to Gillsland and arrived in time for supper—tired but contented.

I have seen much in many lands, but in my store of mental pictures not the least treasured are the views that I can call up of the bleak north country moor on which I saw the line that marked the limit of the wonderful Empire of a great people.



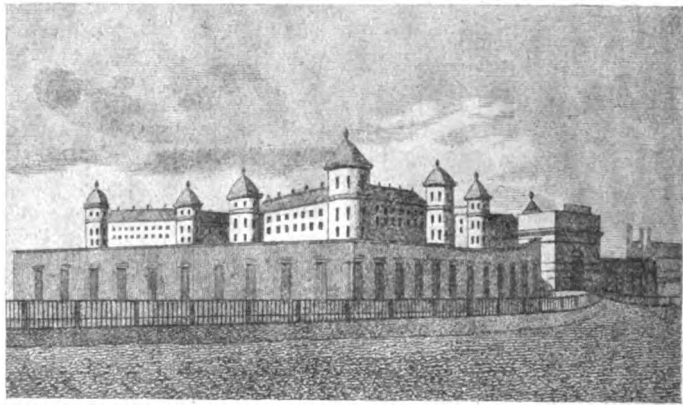
Historical Notes.

THE following brief notes are taken from "Leigh's New Picture of London," published by Leigh and Son, 421, Strand, circa 1833, which gives a brief account of the Millbank Penitentiary.

The italics are ours and indicate that specialist courses and other like conditions existed before the erection of the new Royal Army Medical College which, as most people are aware, is built on the site of the old penitentiary.

"This establishment was formed about 1820 *for the purpose of trying a new system of imprisonment in which the classification and instruction of the prisoners should be particularly attended to.*

"The front faces the Thames and consists of a gateway over which is placed the word 'Penitentiary' in large letters.



PENITENTIARY.

"The external form of the prison is that of an octagon, enclosing about eighteen acres, on which are erected seven distinct buildings, all the rooms in which face the house in the centre where the principal master (Commandant?) resides and has thus a complete view of the whole.

"The rooms are about twelve feet by seven and are each furnished with a bedstead, mattress, rug, bolster, blankets and sheets; they are likewise well warmed and ventilated and glazed inside, having iron bars without.

"The expense of the building is supposed to be about £400,000 or £500,000.

"It was originally intended for the reception of 400 male and 400 female convicts, but is capable of accommodating 200 or 300 beyond that number.

"*The culprits are kept regularly at work in various manufactures and their religious and moral habits attended to.*

"The chapel of the prison is a large and commodious building where the prisoners attend twice every Sunday. The prisoners are entitled to a percentage

on all their earnings, and the amount is set apart for their use on being discharged out of custody.

"None of the prisoners are allowed to see their friends except by an order from the Committee and this privilege is granted to those whose conduct is approved by the Governor, Chaplain, or Master Manufacturer.

"The interview must take place before an officer and no provisions of any sort are allowed to be brought.

"In December, 1831, there were 538 prisoners and December, 1832, 519.

"The earnings of the prisoners amounted to £2,683 10s.

"This prison is governed by a Committee named by the Privy Council and no person can be admitted to see it without an order from the Home Secretary of State or unless he is accompanied by one of the Committee."

Current Literature.

Bacteriology of Influenza in 1919-20. Sindoni, in *La Pediatria*, April 15, 1920.—Pfeiffer's bacillus is almost constant in the naso-pharyngeal mucus of influenza patients, and can be found both in smears and cultures. The organism was not found in healthy persons or in other respiratory diseases. Pfeiffer's bacillus gives rise to specific agglutinins in the blood of individuals who are actually suffering from the disease or have recently had it. The agglutinin content appears on the fourth to the fifth day of the disease, increases during convalescence, and diminishes when the patient is cured.

Carpano, of the Research Institute, Milan, December, 1920, by using serum broth and inoculating the pleural cavity of guinea-pigs, has been able to isolate Pfeiffer's bacillus in all cases if examined very early in the disease, during the 1918 epidemic. Dealing with other respiratory diseases and healthy persons, he states that only one-third of the total yielded Pfeiffer's bacillus. Together with this organism others were almost invariably present, notably streptococci, pneumococci, staphylococci, meningococci, *M. catarrhalis*, &c.

Bulletin Inst. Pasteur, September, 1921: Pilot and Pearlman in the *Journal of Infectious Diseases*, July, 1921, in an article entitled "Bacteriological Studies of the Upper Respiratory Passages in Children," report that out of 115 individuals examined, Pfeiffer's bacillus were recovered forty-seven times from naso-pharyngeal adenoids, and sixty-two times from tonsils. On blood agar its colonies often appear in the hæmolytic areas of streptococci.

Müller in his researches into 102 fatal cases of influenza recovered Pfeiffer's bacillus from the blood of cerebral sinuses in 12 cases, from the lungs in 10 cases. He believes that the causal agent is Pfeiffer's bacillus, and maintains that the many failures are due to faulty technique.

The Measles Exanthem (Quain).—The rash appears on the fourth day after catarrhal symptoms. It is a deep red spotted rash; at first slightly raised and distributed in crescentic groups. The eruption feels rough or shotty, especially on the face.

The Histology of the Measles Exanthem. *Compt. rend. Soc. Biol.*, in epitome, *Brit. Med. Journ.*, March 5, 1921.—When the eruption appears the deeper parts of the Malpighian layer of the skin contain very swollen altered

cells, which stand out from its lower limit and penetrate into the dermis; gradually they become separated from the dermis, lose their nuclei, and are transformed into colourless masses. . . . The changes in the dermis appear later than those in the epidermis and consist in perivascular infiltrations clearly visible on the second day of the eruption, as well as the formation of the sub-epithelial cellular masses already mentioned. There is no evident hyperæmia nor œdema of the dermis.

Pathology of Influenza. (Influenza Epidemic of 1918.) Dr. Adami's paper before a meeting of the Liverpool Medical Society, held on February 10, 1921, and discussion of same.—Dr. Adami showed that in the great epidemic of 1918, in France, Italy, Macedonia, India and America, the disease was uniformly ushered in with congestion of the upper nasal respiratory tract, and the influenza bacillus was invariably recovered. He felt sure that whatever may have been the changes due to other organisms, Pfeiffer's bacillus, if not the *causa causans*, was always associated with the disease. In the autumn the virulence of the organism was raised to an inordinate degree. Four clinical types are described: (1) a mild catarrhal type, (2) a pneumonic type, (3) cases with physical signs of bronchiolitis, and (4) cases of profound toxæmia.

There may be a triple or multiple infection. Professor Glynn quoted several cases in which the bacilli of influenza group were numerous in the trachea and bronchi, but pneumococci scanty. Dr. Lowe pointed out the well recognized importance of the post-nasal space and accessory sinuses as the primary focus of infection. He showed that while in simple cases the intensely inflamed mucosa of those areas gave rise to frequent epistaxis, in other cases which developed later, the severe fulminating type, the condition was due to a generalized bacteriæmia, originating in the infection of the congested pharyngeal veins. This was probably carried in the form of minute infective emboli, travelling by the normal anatomical route and would be arrested in the terminal arterioles of the pulmonary artery, giving rise to peribronchiolitis of hæmic origin (as Dr. French of Guy's Hospital had suggested elsewhere), which would account for the pathological appearances so constant in the more rapidly fatal cases. He pointed out the importance of local hygiene of the posterior nasal space, prophylactic vaccination against the three organisms principally concerned (*B. influenza*, *streptococci* and *pneumococci*) and in the actual treatment the administration of streptococcal sera, fifty to one hundred cubic centimetres intravenously, twice daily. It may here be mentioned that the serum of convalescents has been used with encouraging results.

J. E. H. G.

Glandular Fever. Tydy and Morley. *British Medical Journal*, March 26, 1921.—This fever was first described by Pfeiffer in 1889 as Drüsenfieber. He stated that the disease occurred in small epidemics, especially in house epidemics. Authorities agree that it is infectious and more common in spring.

Clinical Features.—Incubation seven to eight days. An epidemic of fifty-four cases was observed by a Russian in a battalion of soldiers, but apart from this it is probably correct to say that at least 80 per cent of recorded cases occurred under the age of 12. The onset is sudden, as an acute pyrexia; abdominal pain is sometimes present. Enlargement of lymphatic glands may be present early or develop rapidly within twelve to forty-eight hours. The glands constantly affected are the cervical, deep to the sterno-mastoid, about the middle of its length. The glands on the opposite side frequently, but by no means invariably, enlarge later, usually within two to four days of the onset. The initial site is below the angle of the jaw, and the position and general condition of the swelling differs from that of glands secondary to tonsils, teeth, nasopharynx. Enlarge-

ment of other glands has been noticed by most observers. Pain and tenderness of the affected glands may be entirely absent. No rash accompanies, but there is slight reddening of the pharynx. Epistaxis may occur at the onset. Liver and spleen are enlarged in a considerable proportion of cases. The temperature rises to 101.3° F., with a maximum on the second to the fourth day, then falling rapidly and becoming normal early in the second week. In mild forms there may be no rise of temperature. The fall may be so rapid as to suggest a crisis. Bacteriological investigations resulted in the growth of streptococci, staphylococci, pneumococci with influenza bacilli in a certain number of cases. Tchaichowsky claims influenza bacilli from the blood in three cases during life. Records of examination of the blood point to absolute leucocytosis with relative increase of mononuclears. Many observers mention the development of obstinate anaemia. Complications are rare, nephritis being the most important.

Etiology and Pathology.—Gallois, like many of the earlier writers, regards it as a special form of influenza. It is certainly an acute general infection, but it is a question whether it can be considered a disease *sui generis*. Several authorities have upheld the theory of pharyngeal infection. The probability is that this is another manifestation of influenza, due to an associate organism of special virulence, and selective action of the lymphatic tissue.

A medical correspondent of the *British Medical Journal* refers to an unusual epidemic of sore throat, with tedious and considerable glandular enlargement. In one case a macular eruption appeared on the sixth day, it caused some irritation and lasted two days.

Another correspondent states that after a case in his own family (*British Medical Journal*, April 9, 1921) a widespread outbreak of influenza beginning among the elementary school children, developed, and a large number of cases of broncho-pneumonia have occurred.

Carpano, of the Research Institute of Milan, December, 1920, by using broth prepared with hæmolyzed serum, and inoculation in the pleural cavity of a guinea-pig, has been able to isolate Pfeiffer's bacillus in all cases, if examined very early in the disease, during 1918. Dealing with other respiratory diseases and healthy persons, he states that only one-third of the total examined yielded Pfeiffer's bacilli. Together with this organism, others have been almost invariably present, as saprophytes, notably streptococci, staphylococci, meningococci, *M. catarrhalis*, etc., etc. (*Bulletin, Institut Pasteur*, September, 1921).

Pilot and Pearlman (in the *Journal of Infectious Diseases* for July 21) give the results of their bacteriological studies on the upper respiratory passages of children. Out of 115 individuals examined, the bacillus of Pfeiffer was recovered forty-seven times from naso-pharyngeal adenoids and sixty-two times from tonsils; on blood-agar its colonies often appear in the hæmolytic areas of streptococci. The organism has also been recovered very often from the nose or naso-pharynx.

Muller, "Bacteriological Researches in 102 Fatal Cases of Influenza," states that Pfeiffer's bacillus was recovered from the blood of the cerebral sinuses in twelve cases; from the lungs in ten cases. He also believes that the causal agent is Pfeiffer's bacillus, and maintains that the small proportion of positive findings is due to faulty technique. The other organisms mentioned above were found by themselves or associated with it.

Reviews.

NOTES ON LAW AND PROCEDURE AS APPLIED TO COURTS-MARTIAL. By Lieutenant-Colonel St. J. A. Cox, C.M.G. (late Royal Irish Regiment), Courts-Martial Officer, Aldershot Command. Gale and Polden, Ltd. Price 3s. 6d.

This is a carefully compiled handbook of sixty-eight pages giving in convenient form all the important principles of law and procedure arising in the ordinary course, in trials by General and District Courts-Martial.

The author has been guided by errors discovered in the course of review of some thousands of proceedings, and has presented his facts in clear concise form, giving ample references to official manuals.

There is a useful index.

These notes should be invaluable to officers who have limited knowledge of court-martial procedure.

A. D. S.

STUDIES ON INFLUENZA AND ITS PULMONARY COMPLICATIONS. By D. Barty King, O.B.E., M.A., M.D. Edin. M.R.C.P. Lond. and Edin. London: J. and A. Churchill. Pp. 88 + vi., with 31 illustrations. Price 7s. 6d.

This work consists of three studies:—

Study I.—Influenza (1918) and malaria; 150 cases of malaria were received in September, 1918, from Salonica, and influenza broke out among them.

The difficulty of differential diagnosis is insisted upon, and the author rightly observes that the difficulty can be overcome by a combined research from the clinical, bacteriological and hæmatological aspects.

Analytical tables and temperature charts of fatal cases are attached. Of the total, in 110 the type of parasite is recorded; 71 of the 150 developed influenza; 54 of these are classed as follows: malignant tertian, 38; benign tertian, 15; combined infection, 1. Severe and fatal cases of influenza among malignant tertian infections were more than three times more common than benign tertian.

The author is inclined to blame the previous administration of quinine as an important factor in determining a severe or fatal issue of the added influenza infection, by reducing the oxygen carrying capacity of the red corpuscles. This is only a surmise and he admits that oxygen inhalations were also unsuccessful in the treatment of ordinary cases.

The incubation period in ward infections of influenza is given as three to four days. This observation is in accordance with experience elsewhere.

The author discredits quinine in the treatment of the cases of influenza under consideration. He rightly insists on the importance of microscopical examination of the blood for malarial parasites at the outset in a suspected case. He admits that he has never seen quinine fail to lower the temperature at the onset of a case proved microscopically, but denies the value of the drug when influenza-pneumonia is firmly established, on a malarial ground, with or without parasites in the blood. He further categorically condemns the continuous administration of the drug in cases without active malaria as harmful. Though no statement is made as to method of administration adopted, it is presumed that the oral method was uniformly used. This may explain the writer's prejudice against quinine, even apparently in cases where malaria is active or if latent still present beyond doubt.

The analytical tables are certainly instructive, but the following additional information would have been valuable:—

(a) A complete blood examination at the outset of the case, bearing on (1) the presence or absence of malarial parasites and type; (2) total and differential count of white blood cells; (3) hæmoglobin percentage; (4) results of blood culture.

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COLONEL SIR WILLIAM H. HORROCKS, K.C.M.G., C.B.

ASSISTED BY

COLONEL D. HARVEY, C.M.G., C.B.E., R.A.M.C.

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THE FILTER PASSER OF INFLUENZA.

BY HON. LIEUTENANT-COLONEL M. H. GORDON, C.M.G., C.B.E., M.D.

Royal Army Medical Corps.

Bacteriologist and Lecturer on Bacteriology to St. Bartholomew's Hospital.

THE PROPERTIES OF FILTRABLE VIRUSES.

ALTHOUGH it is over twenty-four years since Loeffler and Frosch demonstrated that the virus of foot and mouth disease can pass through the Berkefeld filter, and following on that "key discovery" the infective principles of a large number of other diseases of unsolved ætiology have been found to be "filtrable" in the same manner, the progress of knowledge with regard to the active pathogenic agencies here involved has been remarkably slow. That the infective principles in question are not mere enzymes, but living though extremely minute micro-organisms, is evident from the fact that under favourable circumstances these filtrable viruses are capable of endless multiplication; and further, that when submitted to conditions unfavourable to elementary forms of life, they perish. The filtrable viruses, however, possess certain properties which suggest that the minute living organisms comprising them are somewhat different from the ordinary pathogenic bacteria; thus while the resistance of these viruses to heat is lower, their resistance to glycerine is very much higher than that of most bacteria.

While the label "invisible" or "ultramicroscopic" has been applied to these filter-passing viruses there is reason to suspect that this term is premature until the possibility of rendering them visible by staining or other methods has been explored a great deal further than appears to have

been the case up to the present time. Particularly significant is the information that has been obtained concerning viruses such as those of vaccinia, variola, poliomyelitis, and molluscum contagiosum where the presence of a definite filter-passing micro-organism has been ascertained. In the case of all these viruses the micro-organisms present are described as minute bodies, round or oval in shape, from 0.1 to 0.3 of a micron in diameter, occurring chiefly as isolated individuals, or in groups, but occasionally in the form of diminutive diplococci, and rarely in short chains. These "micro-micro-organisms" fail to stain by Gram's method: indeed, so resistant are they to ordinary stains that it is only by preliminary fixation, by then using a hot mordant, and finally by applying the most powerful of all bacterial stains, namely hot carbolfuchsin freshly prepared, that chief success has been obtained so far in demonstrating their presence. An alternative to this method of Loeffler (introduced originally for the staining of flagella) is to fix the film preparation for twenty-four hours or longer in methyl alcohol or sublimate alcohol, and then to apply Giemsa's stain for twenty-four hours, using preferably several changes of the stain. It is important, however, to note that when a film of filter-passing virus has been stained successfully, these minute micro-organisms may be found present in such enormous numbers that material such as vaccine lymph, or fluid from a smallpox vesicle, even when diluted a thousandfold, is still found to be teeming with them.

The minuteness of these filter-passing micro-organisms—considerably smaller than the smallest of the pathogenic bacteria and only just within the boundary of microscopic vision—coupled with their strong resistance to ordinary stains go far to explain the success with which they have defied research. Add to this the extreme degree of parasitism that numerous unsuccessful attempts to cultivate them on ordinary media has served to illustrate, and the explanation of their immunity from investigation is complete. On the whole, however, it would seem probable that the chief reason why these filter-passing micro-organisms have escaped scrutiny is because the technique for their elucidation is far more difficult to acquire than in case of the ordinary bacteria.

So specialized are the pathogenic activities of the filtrable viruses that Lipschutz has suggested their classification according to the particular tissues upon which they severally operate. Thus, dermatropic viruses include the active principles of variola, vaccinia, varicella, and foot and mouth disease. Hæmotropic viruses include those of pernicious anæmia of the horse and leucæmia of the fowl. Neurotropic viruses include those of rabies, distemper, and of poliomyelitis. Mumps on the other hand is an example of an organotropic virus. Finally, there is a group of filter-passing viruses that produce acute general disease such as measles in man, or rinderpest in cattle. Certain diseases of plants also are known to be due to virus that is filtrable in the same way as the active principles of these diseases of man or of animals.

EXPERIMENTAL INFLUENZA.

Human experiments have already gone far towards solving the ætiology of influenza. The introduction of Pfeiffer's bacillus into the nose and throat of healthy men has failed to produce this disease: thus Sellards and Sturm of Johns Hopkins injected five strains from measles cases without result: Bloomfield used three strains obtained from healthy men on fourteen volunteers without effect: and Davis succeeded in producing only a transient illness in a young man by injecting him with a thick suspension of Pfeiffer's bacillus isolated from a case of pertussis. Wahl, White and Lyall sprayed two volunteers with fresh cultures from cases of influenza: one was unaffected, the other only had a slight reaction in his nose. Lastly the United States Public Health Service in conjunction with the United States Navy Medical Department carried out experiments with Pfeiffer's bacillus isolated from cases of influenza: McCoy and Richey infected five volunteers with a heavy suspension composed of eight strains of *Bacillus influenzae*; but although none of these men had previously had influenza all failed to show any symptoms. Blake and Cecil introduced a new note by raising the virulence of Pfeiffer's bacillus (obtained from an influenza case) by passing it through eleven white mice in succession, and next through thirteen monkeys. They then found that this bacillus freshly recovered from the peritoneal fluid and instilled into the nose and mouth of further monkeys gave rise to a respiratory infection which broadly resembled influenza in man: symptoms began three to five hours after inoculation and included prostration accompanied by sneezing and coughing. Leucopenia was present; and the illness lasted for three to five days. In addition to the very short incubation period, it is noteworthy that fever was small or absent. A striking point is that out of the 12 monkeys infected in this way 5 developed acute suppuration of the antrum from *B. influenzae*, and 2 monkeys got broncho-pneumonia on the third or fourth day. Blake and Cecil inferred that while these experiments established an ætiological relationship between Pfeiffer's bacillus and acute sinusitis, tracheo-bronchitis, bronchiolitis, and broncho-pneumonia, a definite conclusion that this bacillus is the cause of influenza was not permissible owing to the impossibility of determining whether the respiratory disease thus produced in monkeys is identical with influenza in man or not. This question however was solved by Blake and Steffen who injected similar virulent cultures of Pfeiffer's bacillus into the nose and throat of two volunteers and found that while acute respiratory disease was produced broadly resembling influenza, it fell short of the typical clinical picture of that disease. Filtrates of cultures of Pfeiffer's bacillus tried in the same way by Cecil and Steffen on man gave rise to no symptoms of any kind.

In contrast to these negative or doubtful results with Pfeiffer's bacillus are the significant experiments of Yamanouchi, Sakakami and Iwashima who made excellent use of their fifty-two friends—doctors and nurses—

who volunteered for experiment. The sputa of forty-three cases of influenza were emulsified in Ringer's fluid. This emulsion was injected into the nose and throat of twelve healthy persons and the Berkefeld filtrate of it into twelve more. The results were very striking: among the subjects were six who had recently had influenza and these escaped, the remaining eighteen all developed influenza after an incubation period of two to three days. A filtrate of the blood of influenza cases was next injected into the nose and throat of six more healthy persons: the results were precisely the same as in the previous experiments. They next tried the subcutaneous route: four healthy persons received filtered sputum and four filtered blood: all with the exception of one who had previously had the disease developed influenza after an incubation period of two to three days. Lastly a pure culture of Pfeiffer's bacillus and a mixture of Pfeiffer with pneumococci, streptococci, staphylococci and diplococci from the sputum of influenza patients were sprayed into the nose and throat of fourteen healthy persons, but no symptoms and no illness followed these injections. Yamanouchi and his colleagues concluded that influenza is due to a filtrable virus which is present in the sputum and blood of patients and can infect either by implantation on to the mucous membrane or by inoculation, and that Pfeiffer's bacillus and other bacteria found in the sputum are not the cause of influenza. They point out that all the subjects who had influenza, or who received the sputum emulsion or its filtrate, became immune.

Taken with the failure of Pfeiffer's bacillus to reproduce the disease, and the positive results with filtered material on human subjects reported previously by Nicolle and Lebailly, de la Rivière, and others, these Japanese experiments would appear to establish the fact that the primary infective agent in influenza is a filtrable virus. A completeness at present lacking would have been given to their observations had the Japanese investigators shown that the filtered blood or sputum from influenza cases loses its power of reproducing the disease when heated for half an hour to 55° C.

SEARCH FOR A FILTER-PASSING MICRO-ORGANISM IN INFLUENZA.

Before the recent pandemic of influenza, it had been demonstrated by Kruse and confirmed by Colonel George Foster, of the U.S. Army Medical Corps, by means of human experiment that the virus of the common cold is a filter passer. Foster succeeded in cultivating in Noguchi medium a minute micro-organism from the filtered nasal secretion at the onset of acute coryza, and when a culture containing this micro-organism was instilled into the nostrils of volunteers coryza followed, and the filter-passing micro-organism was recovered from the nasal secretion. The incubation period was eight to thirty hours, and similar whether the diluted and filtered nasal secretion was used, or the culture of the filter passer. It should be added that Foster's observations were made on volunteers from a garrison of 250 soldiers, and that they were carefully controlled.

It was to be expected *a priori* that attempts to define the primary infective agent of influenza by animal experiments would be far less conclusive than experiments on human beings. During the pandemic of 1918, the late Major H. Graeme Gibson, of the Royal Army Medical Corps, and his colleagues, Major F. B. Bowman, C.A.M.C., and Captain J. T. Connor, A.A.M.C., while attached to the British Expeditionary Force in France, showed that filtered or unfiltered sputum taken from cases of influenza at the earliest stage of the disease produced in the inoculated animals—monkeys, rabbits, mice, and guinea-pigs—pulmonary lesions closely resembling those found in the lungs of patients who succumb at an early stage of influenza. They were also able to transmit the disease from animal to animal. By employing Noguchi medium they succeeded in growing a filter-passing micro-organism (*a*) from the kidney of animals thus injected, (*b*) from the filtered extract of the lungs of these animals, (*c*) from the filtered sputum of human cases at the early stage of influenza. Cultures containing this micro-organism on inoculation into animals gave rise to pulmonary lesions similar to those produced by the sputum of patients, or by its filtrate; and the disease thus induced was transmitted from animal to animal. They concluded that the primary infective agent in influenza is a filtrable virus, and that the micro-organism cultivated by them was in all probability the primary cause. They were struck by the degree of pulmonary damage that might be present in these animals without any marked clinical evidence of disease. When the monkeys developed symptoms, they appeared on the fifth to seventh day after inoculation, which would seem to be an unusually long period of incubation.

The filter-passing micro-organism was described by them as follows:—

“Numerous small coccoid bodies in size varying from about 0.1 to 0.2 of a micron, generally single, but often taking on a diplococcal arrangement and sometimes occurring in small agglomerations. Some showed a rather delicate halo the significance of which has not yet been determined. With Giemsa they usually stained a deep purple, but some which were apparently degenerate were paler in colour and of a pinkish tinge.” On this first occasion on which they recovered this organism they found it to be Gram-negative, but they stated that since then in young cultures the organism might be Gram-positive. There is some reason, however, to doubt the correctness of the latter statement.

Independently of Gibson and his colleagues, Bradford, Bashford and Wilson recorded similar observations during the same outbreak. They found evidence of the presence of a filter-passing organism of similar morphology and succeeded in producing in experimental animals pulmonary lesions resembling those of influenza. Subsequent attempts, however, by Wilson to investigate the filter-passing micro-organism further were unsuccessful, and in a note appended to a criticism by Arkwright of this work Wilson and Bashford withdrew their claim that such a micro-organism had been cultivated.

In two recent papers on the aetiology of epidemic influenza, Maitland, Cowan and Detweiler, of Toronto, report the result of their experiments in search of a filter-passing virus. Cultures in Noguchi medium were made from filtered nasal washings of one case, and from filtered plasma and filtered corpuscles of three cases, including the patient whose nasal secretion was filtered and cultivated. The actual stage of the attack when these materials were taken is not clear. Three samples of ascitic fluid were used, but no mention is made of their hydrogen ion concentration. A careful series of controls was set up. The results were quite negative. Maitland and his colleagues justly remark that these observations are too meagre to exclude a filter-passing organism as the ætiological factor in influenza. The observations of these investigators, however, served to bring out an important source of fallacy with regard to pulmonary lesions occurring in experimental animals—lesions corresponding in some respects with those described by the previous two groups of workers as occurring in animals after inoculation with influenzal material or cultures. They found in the first place that hæmorrhages into the alveoli and sometimes into the bronchioles, but no leucocytic reaction in the lung tissue, occurred as an agonal phenomenon in guinea-pigs fairly frequently, and may be present in control animals. They also observed that a second kind of pulmonary lesion may occur spontaneously in these animals, namely, a slow proliferation of the cells of the alveolar epithelium. While these hæmorrhagic and endothelial lesions may be found in the same area, they appeared to be independent. The explanation of the proliferative lesion is left open by them. These observations by Maitland and his colleagues are of much importance as indicating a possible source of error in experiments of this kind: but a comparison of their figures with those representing the microscopical appearances of the lungs of experimental animals and attached to the report of Gibson and his colleagues is reassuring, for prominent features in the latter are the presence of oedema and inflammatory exudate. Maitland and his colleagues are also entirely in error in assuming that the purely destructive if “wholesome” criticism of Arkwright necessarily invalidates the careful, laborious and constructive work of Gibson and his colleagues with regard to the presence of a filter-passing micro-organism in influenza, as the sequel has shown.

During the past three years Olitsky and Gates of the Rockefeller Institute have published a series of studies on the ætiology of influenza that have not only confirmed and added precision to those of Gibson and his colleagues, but also promise to place this matter of the filter-passing micro-organism on a new and firm experimental basis. Starting with the nasopharyngeal washings of cases within the first thirty-six hours of the disease they showed that this material *unfiltered* produces on intra-tracheal injection into rabbits a leucopenia falling especially on the lymphocytes, a lesion which appears to be particularly constant in influenza of the human subject. Accompanying this leucopenia they found pulmonary lesions

characterized by hæmorrhage, emphysema and œdema. The important point, however, is that Olitsky and Gates were able to transmit this syndrome in series, and to carry it on from rabbit to rabbit for as many as fifteen passages. Controls made in the same way with nasopharyngeal washings from sixteen non-influenzal cases including cases of coryza, also from cases of influenza after the second day proved negative. Foreign protein (e.g., human ascites fluid), *B. influenza* or its toxin prepared by Parker's method all gave negative results. Having thus proved that the diluted nasopharyngeal secretion at the onset of influenza has a peculiar pathogenic effect on rabbits, they proceeded to show that this action is still possessed by the secretion when the bacteria have been removed from it by Berkefeld filter. Still using the peculiar rabbit reaction as guide, they next showed that the pathogenic agent present in the nasopharyngeal secretion resists the addition of fifty per cent of glycerine for periods up to nine months, and finally that it consists of a minute "bacilloid" body 0.15 to 0.3 micron in length, which they cultivated in Noguchi medium, using ascites fluid, having a p.H. of not over eight and preferably 7.8. In papers published during the present year, Olitsky and Gates report that they have succeeded in growing the filter-passing micro-organism anaerobically in fluid media containing reducing substances other than rabbit kidney—for instance suitable conditions can be established either by first growing *B. coli* in the medium for a few hours and then killing it by heat, or by adding unheated vegetable tissue to the medium as suggested by Avery and Morgan who recommend pieces of potato, carrot or banana for this purpose. Furthermore, Olitsky and Gates have succeeded in growing this filter-passing micro-organism of influenza under strict anaerobic conditions on agar plates enriched with nothing more than five per cent of rabbit's blood. On the latter medium fine colonies may appear within a week, and the filter-passing micro-organism may develop into a spindle-shaped rod as much as a micron in length; though it reverts to the smaller original form when transferred to the Noguchi medium. They have succeeded in proving that an immunity results in the rabbit from inoculation either with the nasopharyngeal secretion of influenza cases, or with the Berkefeld filtrate therefrom, or with the filter-passing micro-organism isolated from either of these materials; and by a series of cross-tests they have satisfied themselves that the immunity in all three instances is identical. This specific immunity appears to last in the rabbit for at least fourteen months. Lastly, they have established experimentally the formation of specific antibodies (complement-fixing substances, agglutinins, etc.), to this filter-passing micro-organism.

PERSONAL OBSERVATIONS.

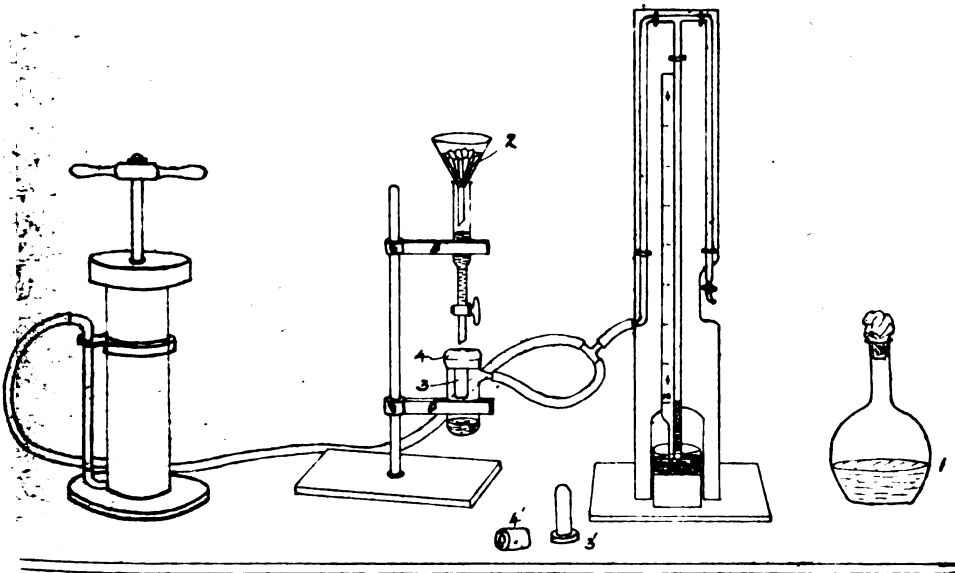
Early in the present year (1922) a sharp outbreak of influenzal illness occurred among the nursing staff of St. Bartholomew's Hospital. I am indebted to Dr. W. P. S. Branson for the following particulars of the

epidemic. Between December 23, 1921, and January 23, 1922, fifty-seven nurses were attacked; the majority between December 25 and January 3. The disease was characterized by its sudden onset, and by the fact that for the time being it completely incapacitated the affected. The average duration was three days febrile illness necessitating a stay of altogether five days in bed, and an average absence from duty of seventeen days. Signs and symptoms at the onset were congested conjunctiva and facies, coryza, furred tongue, rapid pulse and pain in the back. The average highest temperature was 102° F. With regard to complications these fortunately were rare; one case developed bronchitis that did not pass into pneumonia, and one case of mastoiditis occurred.

Technique.—During the previous six months I had been practising the Noguchi method of culture on various occasions. It may be of interest to state that of three specimens of ascites fluid obtained for this purpose from cases in the hospital all were found to be too alkaline when their p.H. content was kindly examined by Mr. Archer. The two specimens of ascites fluid used in the following observations needed in the first case 0.5 cubic centimetre, and in the second 0.8 cubic centimetre of N/20 HCl per 10 cubic centimetres of ascites fluid to bring their reaction to 7.8—the figure specified by Olitsky and Gates. After their reaction had been corrected in the manner stated, the specimens of ascites fluid distributed in ten or twenty cubic centimetre amounts in test tubes were repeatedly heated to 55° C. for at least half an hour, and then stored for use when required. Their sterility was above suspicion. The manipulations to secure pieces of fresh kidney aseptically from the rabbit were essentially similar to those described by Foster and by Gibson and his colleagues with regard to the use of freshly sterilized instruments for each stage of the incision. I have preferred, however, to remove the kidneys through a lumbar incision rather than by the abdominal route, and after it has been anæsthetized, bled, and killed, the rabbit is skinned and soaked in strong izaral before incising the lumbar muscles in order to obtain the kidney. Each kidney should be removed as neatly and quickly as possible with freshly flamed scissors and forceps, and transferred to Petri dishes, where they may be cut up at leisure into pieces of the requisite size for transference to the long tubes used in this work. A trained assistant is necessary in these manipulations; no visitors and no talking should be allowed. I have formed the opinion that the kidneys of young rabbits give better results than those of old animals in this work. Each piece of kidney transferred to a long test tube (20 centimetres long by 1.25 to 1.5 centimetres broad), has a little ascites fluid added to it, and is incubated for two days before use, so that any tubes showing contaminations or cloudiness can be rejected.

The diluted nasal or pharyngeal secretion from four nurses within twenty-four hours of onset was put through filter paper, then through the Berkefeld filter, by means of the arrangement shown in the diagram (which

was kindly drawn for me by Dr. T. G. M. Hine) a fresh funnel, filter, and holder being used for each. One cubic centimetre of each filtrate was inoculated into each of two Noguchi tubes, and one cubic centimetre into an ordinary broth tube. After filling up the Noguchi tubes till each contained ten cubic centimetres of ascites fluid, they were sealed with a layer of wax and vaseline. The first Noguchi tube was then heated for half an hour to 55°C ., after which all three tubes were placed in the incubator. All the broth tubes remained sterile. In each case the unheated Noguchi tube showed between the fourth and sixth day a cloudiness near the piece of kidney at the foot of the tube precisely in the manner described by Olitsky and Gates. In each case also the heated Noguchi tube remained



Apparatus for filtering. 1, Flask with saline gargle; 2, funnel with filter paper; 3, Berkefeld filter, of shape shown in 3' held in position by rubber cap, 4 and 4'. The receiver of the Berkefeld filter is connected to a manometer and air-pump; a minus pressure of 10 cm. of mercury is ample.

free of cloud over this period, as also did a control tube of the Noguchi medium left uninoculated and incubated with the rest. On examining the positive cultures with Gram's stain, no bacteria could be found, and sub-cultures on ordinary agar failed to grow.

When films of material taken from the foot of the positive cultures were fixed in methyl alcohol for twenty-four hours, and then stained in five per cent Giemsa for a similar period, and lightly differentiated in equal amounts of acetone and xylol swarms of minute round bodies which had for the most part a purple tint, but occasionally red, were found on careful examination. These bodies are very easily missed unless specially

looked for, and would inevitably be dismissed as "ground" by an inexperienced observer. Having failed to find these minute bodies in the control tubes, I proceeded to look up the literature of filter-passing micro-organisms, and was much struck by the photographs of those found by Paschen in vaccine lymph which are included by Lipschutz in his article in Kolle and Wassermann's text-book. Having obtained some fresh vaccine lymph through the courtesy of Mr. Fremlin, I proceeded to examine films of it by the staining method recommended by Paschen, and after some difficulty succeeded in finding these bodies by using a modification of Loeffler's flagella stain. Having come to the conclusion that these bodies in vaccine lymph are of the same order as regards morphology as those present in the influenza cultures, I have since that time been endeavouring to acquire the requisite skill to enable me to investigate these minute micro-organisms, and I am very conscious of the magnitude of the technical difficulties at the present time and of the comparatively slow progress made. Results have been briefly as follows:—

Primary Cultures.—Through the kindness of colleagues and of the medical departments of the Ministry of Health and the London County Council, I succeeded in obtaining material during the late outbreak of influenza in London from sixteen further cases within thirty-six hours of the onset of symptoms, and cultivated the filtrate from each in Noguchi medium as before. Out of the total of twenty cases (including the nurses) in which the filtrate of the nasal or pharyngeal secretion was examined in this way, I obtained evidence of the presence of a filter-passing organism in fourteen. In addition, filtrates from the bronchial secretion were cultivated from three fatal cases of influenza, with positive results in two. The secretion that gave the best growth of the filter passer was literally swarming with Pfeiffer's bacillus; this bacillus, however, failed to pass the Berkefeld filter.

In addition to the above cultures, I have examined similar material from seven cases of measles at the onset of the rash. In three of these cases the filtrate produced some clouding of the Noguchi tube on the fourth to seventh day, and in two of these cultures I succeeded in satisfying myself of the presence of a filter passing micro-organism similar in morphology to that found in the influenza cultures. Both these positive cases, however, probably derived the infection from the same strain of virus, and there are clinical grounds (absence of Koplik spots, and enlargement of glands at back of the neck) for thinking that they were in reality cases of German measles.

Subcultures.—After three weeks' growth, three of the primary influenza cultures were diluted, filtered, and the filtrate sown in fresh Noguchi tubes. Two gave a positive growth; in the third the result was doubtful.

Demonstration of the Filter-passing Organism in situ in the Secretion.—As neither Foster nor Olitsky and Gates mention any observation on this point, I have investigated the matter, and in both of the last two cases of



FIG. 1.—Anaerobic filter-passing micro-organism present in pure culture in kidney-ascites medium inoculated with the Berkefeld filtrate of diluted nasal secretion from a nurse within twenty-four hours of the onset of influenza. After incubation for a fortnight, material from the foot of this culture, which showed no bacteria by Gram's stain, was diluted 500 times in distilled water and then spread as thinly as possible over a coverslip which was allowed to dry in air. The film was fixed in methyl alcohol for one hour, and stained overnight in 5 per cent Giemsa. I am indebted to Mr. J. E. Barnard for the present microphotograph taken at a magnification of 1,000 diameters.

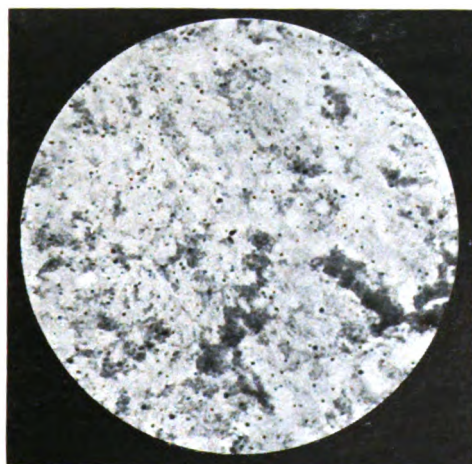


FIG. 2.—Nasal secretion at the onset of influenzal catarrh showing the minute filter-passing micro-organism *in situ*. The preparation was fixed for twenty-four hours in methyl alcohol, stained for a similar period in 5 per cent Giemsa, and differentiated in equal parts of acetone and xylol. A pure culture of the micro-organism was obtained from the Berkefeld filtrate of this material. Magnifying power 1,000 diameters.

To illustrate "The Filter Passer of Influenza," by Hon. Lieutenant-Colonel M. H. GORDON,
C.M.G., C.B.E., M.D.

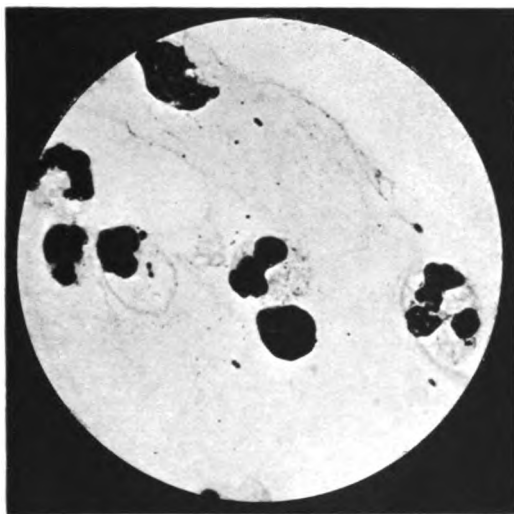


FIG. 3.—Nasal secretion from another case within the first twenty-four hours of onset. The relatively large diplococci are pneumococci. The much smaller filter-passing micro-organism is apparently being phagocytosed by the polymorphonuclear cell in the middle of the photograph. In addition to the usual fixative, this specimen was fixed in warm acetic acid (1 per cent). Stain carbolfuchsin. Magnification 1,000 diameters.

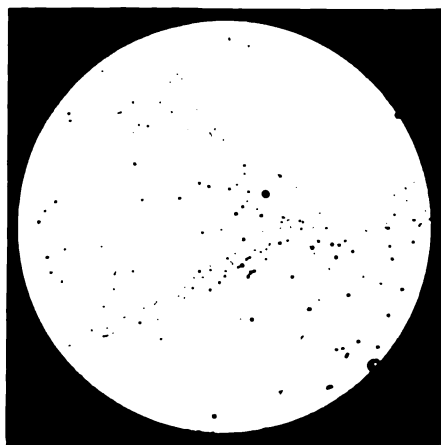


FIG. 4.—Preparation of fresh calf-lymph diluted and mixed with staphylococcus. The filter-passing micro-organism described by Paschen is seen in large numbers, and towards the middle of the field is a single staphylococcus. Stain a modification of Loeffler's flagella stain. Magnifying power 1,000 diameters.

To illustrate "The Filter Passer of Influenza," by Hon. Lieutenant-Colonel M. H. GORDON, C.M.G., C.B.E., M.D.

influenza have succeeded in demonstrating what I believe to be the minute filter-passing organism in large numbers in the nasal secretion during the first twenty-four hours of the disease. In both cases the secretion was clear, and ordinary bacteria were scarce. The stain used successfully was Giemsa, the stained preparations being differentiated as before in xylol and acetone. Confirmatory results were obtained in both cases with methyl blue, and in the last one with azur I as well. Both secretions were filtered and found to yield a positive growth of the filter passer on the third to fourth day. The first case developed symptoms of gastric catarrh two days later, but was well again in a few days, and when his nasal secretion was re-examined eleven days from the onset, no certain filter passers were found either by film or by culture of his nasal secretion.

The morphology of the filter-passing micro-organism from the influenza cases has been accurately described by Gibson and his colleagues. Photographs of it, which I owe to the courtesy of Mr. J. E. Barnard of the National Institute for Medical Research, are attached to the present paper (figs. 1—3). The diameter of the organism shown in fig. 1 is 0.2 of a micron. I think that Olitsky and Gates are perhaps ill-advised in calling it "bacilloid," and the name they propose for it, *Bacterium pneumosintes*, seems to me premature. The general feeling I have is that we are dealing with a new field, so to speak, and that the individual filter passers had better not be given official names until we have agreed upon some family name for the whole group to which a distinctive name for each member may be added later.

It is, I think, self-evident that the relatively slow progress that has been made with the elucidation of filter passers is due to the fact that these micro-organisms require a technique far more difficult to acquire than that which is adequate for dealing with ordinary bacteria. The recent work of Olitsky and Gates, however, promises to simplify very considerably the technique of culture. We are badly in need at present of some simple and fairly quick-staining method that will tell us for certain whether these very minute "stain-fast" organisms are present or not in a given material. For this purpose Loeffler's flagella stain is too complicated, uncertain and dirty. Giemsa is far cleaner and less liable to error, but the long time required for fixing and staining is a drawback, and the final differentiation needs the greatest caution or the finest preparation may be ruined. Furthermore, Giemsa fails occasionally to reveal filter passers; even when these are present in large numbers. Olitsky and Gates use a well-ripened methylene blue (either polychrome or Loeffler's), but the specimens of methylene blue I have been able to obtain, one and all have failed to stain filter passers. My best results so far have been obtained with a sample of methyl blue obtained in 1912 from Grubler. It is, of course, essential to fix these organisms very thoroughly before attempting to stain them. A mixture of equal parts of absolute alcohol, acetone, chloroform, and ether makes a good fixative, and seems to clear the ground—a great source

of error in this work. After air-dried coverslip preparations have been immersed in this mixture for half an hour, I place them in absolute alcohol for the same time, then dry them and place them in one per cent acetic acid for a few minutes, after which they are left in 1:200, or better, 1:400 methyl blue overnight. When other methods fail, I fix two preparations in the manner stated, and then warm one in one per cent acetic, the other in one per cent NaOH until vapour arises, then after a thorough wash in water and alcohol, place the films in watch glasses containing carbol-fuchsin, which are covered over and placed for half an hour in the 55°C. incubator. In studying the staining of filter passers, I have found it helpful to dilute the culture about 500 times in distilled water, and to mix some of this dilution with a fresh emulsion of staphylococcus. The staphylococcus is easy to focus, and enables one to find the field far more easily than when the minute filter passer alone is present. The very reluctance of filter passers to stain with ordinary bacterial dyes can be applied to differentiate them from accompanying bacteria. Thus a mixture containing 1:5,000 to 1:10,000 of ordinary basic fuchsin, and 1:200 to 1:400 methyl blue has been found to stain staphylococci a brownish red colour, and the accompanying filter passer a light blue. It is not every specimen of methyl blue, however, that is successful, and the value of this and other stains for demonstrating filter passers is a matter calling for further investigation.

Search for the primary infective agent in influenza, therefore, has led us into the realm of filter passers, and has revealed the presence of a micro-organism of this group. The further properties of this micro-organism and its precise relation to others including the similar filter passer cultivated by Foster from the nasal secretion during the acute stage of the common cold are matters awaiting research.

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HÆMATOPHAGY AND HÆMETABOLY AS A NORMAL FUNCTION OF VARIOUS TYPES OF TISSUE-CELL.—I.

By H. M. WOODCOCK, D.Sc.LOND.

*Fellow of University College, Head of the University Department of Protozoology.
(Lately Protozoologist to the Egyptian Expeditionary Force.)*

(Continued from p. 426, Vol. XXXVIII.)

GENERAL CONSIDERATIONS.

The above are the chief positive observations on which I base my view of the mode of formation of the colloid of the thyroid gland. To these have to be added certain "negative observations," the evidence afforded by which all points in the same direction. In the first place, it has been already mentioned that the epithelial cells of the follicle do *not* contain iron, apart of course, from the chromatin of their nuclei. Whence, then, can the colloid obtain the quantity of iron which is invariably present in it, except directly from the hæmoglobin of the red corpuscles? Further, quite apart from the question of iron, *I fail to find the slightest evidence of the origin of the colloid in and from the protoplasm of the cells themselves.* Whether stained by iron-hæmatoxylin and eosin and differentiated to any extent preferable, so that either the black or the pink stain predominates, or whether stained by the Ehrlich-Biondi-Heidenhain stain, as a predilective gland cell stain, nothing that can be regarded as secretion of colloid can be found. Moreover, I look in vain in the published figures, e.g., of Hürthle (l.c.) or McCarrison (l.c.), for anything that could confidently be taken as an indication of such. In the excellent coloured figures given by the former, the colour of the colloid after his selected stain (E.-B.-H.) is quite different from that of the cytoplasm of the cells, just as it is in my preparations similarly stained (cf. figs. 11 and 12). And the appearance of Hürthle's "colloid cells" certainly does not support his view that those are colloid-containing. Indeed, Hürthle's distinction of the epithelium into "chief cells" and "colloid cells" has already been given up. Both McCarrison, and Jordan and Ferguson in their recent text-book of Histology [5], regard these as variations representing different stages of secretion in the same cell-type. The slight variations in granularity which I have observed—a coarsely granular condition which is quite different from the appearance of the colloid—I regard as being rather the varying expression of slight differences in a reticular character shown by the cytoplasm. On the other hand, the frequent occurrence of red corpuscles in the colloid has often been pointed out; but their presence has been regarded merely as the result of slight hæmorrhages. Further, it has also been often noted (e.g., by Jordan and Ferguson, l.c.) that when stained

with eosin, the colloid takes a tint "closely resembling that acquired by the hæmoglobin" of the corpuscles. Having regard to all the above points, is it not most reasonable, I ask, to consider that this recognized influx of corpuscles is not an "abnormal" occurrence, but indicates a normal mode of behaviour, connected with a definite function of the thyroid, namely, the transformation of the hæmoglobin into colloid material?

The necessary quantity of the ferment or enzyme which brings about the metabolization may be relatively small; and I cannot say that I have been able to distinguish cells in process of the active production of the colloid-forming ferment from those in a "resting" condition in this respect. As in the various cases considered previously, the ferment concerned is most probably produced in the first place by the nucleus and passes thence (normally) into the cytoplasm. I think the ferment is passed out of the cell into the lumen of the follicle in solution, by diffusion or osmosis. Where the formation of colloid, i.e., the metabolization of the corpuscles, alone is taking place—and this proviso is important, in view of what I have to say shortly—the limiting membrane of the inner face of the cells, abutting on the lumen, always appears unbroken, constituting a definite, regular edge to the epithelial wall (cf. my figures); I except those cases, of course, where obvious disruption of the cells is occurring, or has recently occurred, consequent on the penetration of corpuscles *en masse* into the lumen.

Just as I can find no evidence of the secretion of the colloid by the cells, so I can find no indication of its re-absorption by the latter, as McCarrison considers to be the case. The vacuolated appearance at the periphery of a mass of colloid, which McCarrison regards as evidence of absorption, I regard as the result of an influx of odd corpuscles, or corpuscular masses, which are usually pallid, or else in the early stage of colloid-formation (cf. fig. 8, which shows this condition well). Moreover, these bleached, or pale pink little masses (as the case may be) are definitely surrounded by formed colloid; even between them and the epithelial cells, there is usually a narrow, but definite zone of pink colloid (cf. fig. 14). These small masses, on penetration, tend to become enclosed or surrounded by the colloid already present. Hürthle's figures, for instance, also show very clearly the well-defined, sharply delimited character of these "vacuolar" corpuscular areas, although he failed to realize their significance. Now, if this appearance really represented absorption of the colloid by the cells, it is very difficult to understand why a narrow layer of unaltered colloid should be left unabsorbed immediately next to the epithelium; this would naturally be the first to be absorbed. Moreover, not infrequently, these pallid corpuscular areas may be observed right in the colloid—even near the middle.

Certain preparations which I made specially for this purpose conclusively settle, in my opinion, this point. A small portion of a gland was fixed quickly in the sublimate-alcohol-acetic mixture, being left in only for a short time, about fifteen minutes; it was then brought up through

16 *Hæmatophagy and Hæmetaboly as a Function of Tissue-cells*

the alcohols, etc., and embedded as rapidly as possible, in order to retain as much as possible of the natural colour of the hæmoglobin of the red corpuscles, which are rather apt to be slightly decolorized by being kept too long in the alcohols. Sections were stained for a short time in well-acidulated Delafield's hæmatoxylin alone. In such sections, the normal corpuscles have retained well their yellow colour, which contrasts with the purple of the cell-nuclei and the rather lighter mauve of the colloid. In many of these corpuscular "vacuoles," a faint yellow tint is still distinctly apparent, indicating recently penetrated corpuscles which have not yet become completely bleached.

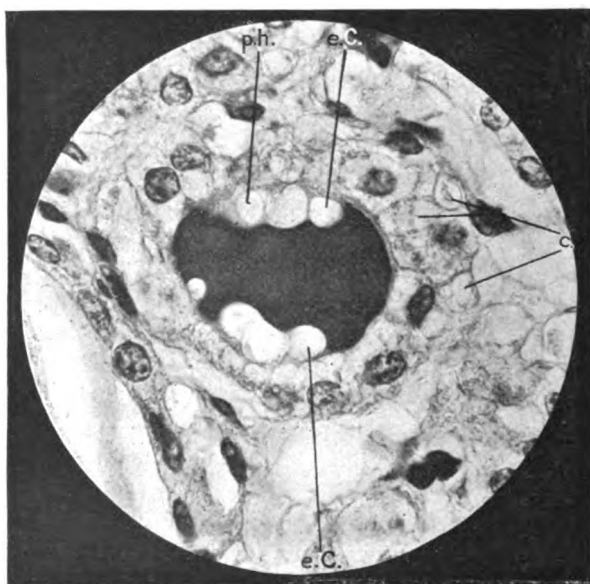


FIG. 14.—To show the penetration of hæmoglobin masses into the lumen of an acinus, and the resulting "vacuolated" appearance of the colloid: c., corpuscles at the outer edge of the wall, or passing inwards (other pallid corpuscular areas are seen in various places around, cf. above, to the left); p.h., pallid hæmoglobin mass; e.c., corpuscular masses in the stage of early colloid, now staining uniformly pale pink. (Iron-hæmatox. + eosin; $\times 750$, approx.)

As to how the colloid gets from the lumen of the acinus into the lymph-channels, I think the answer may be in part supplied by the explanation given by Hürthle. This author considers that the disintegration of the epithelial wall in places, as some of the cells become effete and die, allows the colloid to gain the outside of the follicle and thus reach the lymph (and it may be also the vascular) channels. Its passage to the exterior is probably assisted to some extent at times of the inbursting of the corpuscles owing to temporary local increases in the blood-pressure, where this takes place into lumina which contain colloid. Both Hürthle and McCarrison think that another way in which the colloid passes out is by it permeating

interstices between the epithelial cells; McCarrison observed this process only in congenital goitres of goats, where there was enormous production of colloid. I cannot say that I have ever seen any indication of this behaviour and I do not regard it as being likely to constitute a common mode of egress, normally, of the colloid.¹ On the other hand, I think there is another possible manner, to which reference is made below (p. 23).

A TRUE PROCESS OF SECRETION.

In addition to the colloid, formed by the metabolization of the red corpuscles, there may also be present, I consider, in the lumen of the follicle, some liquid substance which has been secreted by and in the epithelial cells themselves; that is to say, a true secretion and not so far as I can ascertain the result of hæmetaboly. Strictly, therefore, this does not come within the scope of my work. But as the production of this secretion stands in very close relation with the question of the characteristic crenations often shown by the colloid, which are regarded by many as being due to shrinkage or retraction, it is worth while to indicate what I have found and how I think this appearance is to be explained.

In some follicles, which contain already fully formed colloid, the free, inner face of certain of the epithelial cells, abutting on the colloid, appears different from what is usually the case. Instead of presenting a regular, even edge, forming a flat wall to the lumen (as for example, in figs. 6, 8 and 10), some of the cells may be greatly expanded, in a radial direction, and bulge inwards into the colloid: in this case they present a prominent, markedly curved free border in contact with the colloid. This condition is well shown by three cells of the central follicle in fig. 10, and by several cells of the two complete follicles seen in fig. 15 (especially at s.c.). At first, the reticular cytoplasm of the cells fills these prominences. But, in a later stage, the cytoplasm becomes looser, more alveolar in character and gradually breaks down, its place being occupied by a colourless "vacuole" (s.c. i); in my opinion, this "vacuole" contains, at any rate, in life, the true cell-secretion. Subsequently, a new cell-border, definitely limiting the cytoplasm, is formed on the outer, i.e., nuclear side of the "secretion-vacuole" (an indication of this is seen in the second cell below that marked by the arrow, s.c. in fig. 15). Finally, the lateral walls of the protuberances of adjacent cells (i.e., the old cell-borders) more or less break down and the secretion-vacuoles run together; in other words, the secretion from these particular cells is now contained in a larger, continuous space (s. sp.).

For a time the margin of the colloid adjoining this secretion is conspicuously indented or crenated, the shape corresponding with the inden-

¹ Müller [8] also expresses doubt about Hürthle's view as to the passage of the colloid outwards, by fine, intercellular channels and thinks the appearances on which this author based his opinion might be merely those of the cell-walls cut obliquely.

18 *Hæmatophagy and Hæmetaboly as a Function of Tissue-cells*

tions which have been made by the bulging, secreting cells (cf. the colloid near to s. sp.; and this crenation may be distinctly more pronounced). But later, the margin of the colloid is gradually moulded and flattened, and becomes more regular in contour; thus, for instance, in the central follicle of fig. 10, where the colloid is well separated from the wall on its upper side, it has now become fairly regular in outline, except towards the upper, left-hand margin, where it is still slightly indented (cf. also fig. 11).

After the process of secretion is finished, the epithelial cells become very flattened (cf. the upper part of the wall in fig. 10; also left-hand side

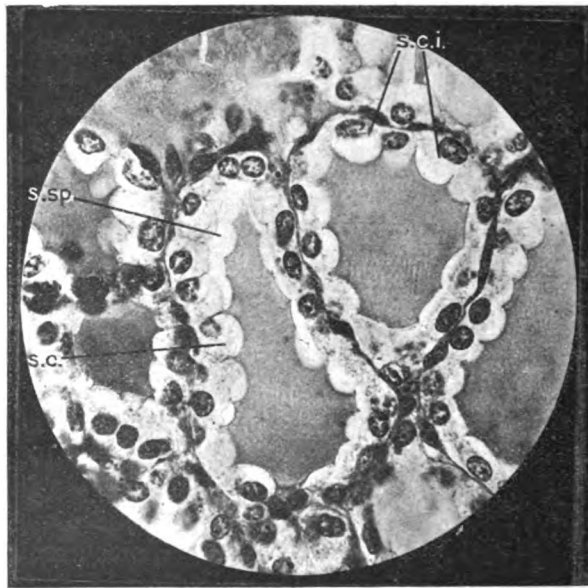


FIG. 15.—To show the process of secretion by the epithelial cells, and the resulting crenated appearance of the edge of the colloid (for description see text). s.c., cells in early stage of secretion; s.c.i., cells in which a secretion-“vacuole” has been formed; s.sp., space which contains the secretion, after the lateral walls of the cells have broken down. (Flemming-osmic acid; iron-hæmatox. + eosin; $\times 500$.)

of the middle follicle in fig. 12). I find this flattened appearance of the cells very commonly where the colloid is separated—it may be only in part, in any one acinus—from the wall of the same. On the other hand, where the colloid is still contiguous to the epithelium, and the true secretion has not yet been formed, the cells are cubical, or shortly columnar (contrast fig. 12 again, the wall of the follicle partly seen on the extreme right).

I consider, therefore, that neither the curious crenated form often shown by the edge of the colloid, nor the space seen in certain follicles between the colloid and the wall (or a part of it) is, in general, the result of retrac-

tion or shrinkage of the colloid during fixation; I think these appearances represent different conditions occurring in the follicle during the course of the true secretory process. And I think that these clear, apparently empty areas, whether in the form of cell "vacuoles," or as a continuous space, were occupied in life by a true liquid secretion of the cells. In the preparation of the sections, this liquid has, in all probability, been washed away; just as, in a similar manner, it may be recalled, in a dried smear containing Kurloff bodies, where the delicate wall of the lymphocyte has been ruptured, the homogeneous, liquid contents of the "vacuole" are nearly always missing.

As bearing on my view, it is interesting to note that one of the very early workers on the thyroid, Baber says [2], that, in addition to the colloid, "a small quantity of a pellucid substance" is sometimes present in the vesicles. The majority of workers, *e.g.*, Bozzi [3], Hürthle (*l.c.*), and others, have regarded the peripheral vacuoles at the edge of the colloid as due to shrinkage or contraction, but as they did not distinguish, of course, between vacuoles containing hæmoglobin and those containing the true secretion, it is not usually clear to which they were referring; they probably included both types. Müller, however, realized [8] that some of these vacuoles, appearing like "silvery droplets," contain a cell secretion. This author, while considering that Hürthle's view, that the vacuoles are artefacts resulting from the fixation and hardening, was to some extent true, pointed out that, nevertheless, some cells show a connexion with these droplets of secretion, and therefore he regarded the hyaline little vesicles as arising out of the cells.

There are other reasons against considering the appearances I have just described as the result of shrinkage. In the first place, they may be found whatever fixation has been used; for instance, after fixation by my Flemming-osmic acid mixture equally as after fixation by other methods. Figs. 10 and 15 are both purposely taken from sections of material fixed in the former way. Again, adjacent follicles in the same section often vary greatly in respect of these appearances; in one the colloid may be contiguous with the more or less uniform border of the epithelial wall, whereas, in a neighbouring follicle, there may be either a crenated appearance of the colloid, or there may be a considerable space separating this from the wall. Even in one and the same follicle, the cells are usually in different phases as regards this secretion; the process does not occur uniformly at the same time throughout the acinus. Some cells may be only commencing to secrete, when others have finished the process and become flattened (*cf.* fig. 10). Again, some cells may be engaged in producing the colloid-forming ferment wherewith to metabolize corpuscles which have recently penetrated into the lumen, while other cells, in the same follicle (abutting on a "space") have finished secreting the true secretion, and become flattened (*cf.* fig. 12). No, I do not think it can reasonably be concluded that a haphazard shrinkage-effect is responsible

20 *Hæmatophagy and Hæmetaboly as a Function of Tissue-cells*

for such variations, which can be met with in the same field of a section and after various methods of fixation!¹

It has to be borne in mind that these so-called shrinkage "vacuoles" and appearances indicate one of two entirely different processes, namely: (1) the bleaching of corpuscles and their subsequent metabolization into colloid; and (2) the production of the real secretion. The manifestation of these two processes, respectively, can be distinguished in the following ways. Corpuscular "vacuoles" are complete, that is to say, they have a well-defined edge or contour completely enclosing them; they are regular in shape, round or oval. On the other hand, a "vacuolar" or crenated appearance of the colloid, due to the production of the cell secretion, is always incomplete, i.e., it never has a complete contour or border, this being at most approximately hemispherical—more usually an arc. Its flatter base is formed by the cell, either by the newly-constituted cell-membrane, or by the loose, rather irregular cytoplasm. Further, the diameter of this arc is distinctly greater than that of a corpuscular "vacuole" containing a single corpuscle; because the width of an expanded secreting cell is always more than that of a red corpuscle. Where, however, the corpuscular vacuole consists of two or three corpuscles together, as occasionally happens, this difference in size (only) may not be noticeable.

Another most important point is that secretion "vacuoles" are *always colourless*; this is probably because, in a section, they are actually empty of secretion, but whether the secretion may still be present in some of the unbroken secreting cells or not the corresponding area always appears unstained. Moreover, not infrequently, a few odd granules or little streaks representing minute fragments of the reticular cytoplasm can be seen in "vacuoles" of this type. On the other hand, in any acinus showing corpuscular areas in the colloid, one or more, at any rate, can generally be found in which the altered hæmoglobin is beginning to *stain again* a faint pink, i.e., some are in a rather later stage of the hæmetaboly; and in whatever stage of the metabolization they are, these little areas possess homogeneous contents and never show loose cytoplasmic granules or fragments.

I wish to emphasize again that it is *not* the process of cell-secretion which produces the *colloid*. On the one hand I have what is, in my opinion, satisfactory evidence that the colloid is formed by hæmetaboly, and, on the other hand, I can find not the slightest evidence of the transformation of the secretion into colloid. I have only seen this secretion

¹ Of course, I do not say that there is no retraction whatever of the colloid, but I certainly consider the specific appearances I have dealt with do not represent such shrinkage but are to be explained in the manner indicated. However, particularly in the case of large follicles containing great masses of colloid (as, for instance, in the adenoma studied), there may be a little contraction, but it is away from the epithelial wall, *more or less evenly and uniformly all round*, and this may be the result of a certain amount of natural self-contraction of the colloid, as this ages, as well as being due to fixation.

taking place into a lumen already containing formed colloid; I have never seen any indication of expanded, actively secreting cells in the case of a follicle empty of colloid, and I consider, therefore, that the true secretion is only produced after the colloid is already formed. Whether the secretion has any effect upon the colloid itself I cannot definitely say. But I am inclined to think that the secretion may possibly dissolve a certain amount of the colloid, which then leaves the lumen of the follicle and is conveyed to the body in solution. Because in many larger acini, which are only partly filled with colloid, or contain only a small amount, the inner margin of the colloid abutting on the "space" does not present a firm, well-defined border, but appears very loose and trails out, as it were, in the form of irregular streaks and clumps of granules. This is rather suggestive, therefore, of a process of solution or partial liquefaction having been at work, as a result of which much of the colloid has escaped from the lumen of the acinus (cf. the large follicle in fig. 13).

An interesting point to note is that, in the adenoma, I look in vain for any evidence of the production of this true secretion by the cells. In spite of the abundant formation of colloid, and the quantity present in many acini, none of the cells are in the condition shown in fig. 15. It appears as if the functional activity of the growth were concentrated on the production of the colloid material only, by means of hæmetaboly.

In regard to one important point, I have been, unfortunately, unable to ascertain anything, that is, as to the iodine content of the gland, where the iodine is actually located ("fixed"), whether in the colloid, or in the secretion of the epithelial cells, or in both these situations. So far as I have been able to gather from the literature this question does not appear to have been settled, because desiccated extracts of the gland itself for macro-chemical analysis (as in the valuable work of Kendall) do not answer it. All my attempts to "free" the iodine, however, so that its situation could then be revealed by a micro-chemical test, have proved unavailing.

AN INDICATION OF THE SIGNIFICANCE TO BE ATTACHED TO THIS INSTANCE OF NORMAL HÆMETABOLY AS A PRECEDENT.

It is seen, therefore, that the exercise of this function of hæmetaboly is *not* normally restricted to the macrophages. A tissue-cell type of hypoblastic origin, the epithelium of the thyroid, also customarily behaves in this manner in order to produce one portion, at least, of the secretion of this gland, namely the colloid. This first case is most important, in my opinion, as a precedent; it establishes the principle. And the possibility—even the probability—has at once to be envisaged that this is by no means an exceptional instance, but that other types of tissue-cell may form "secretory" or "excretory" products in a similar way; especially is this likely to be the case as regards portions, at any rate, of the secretions of other notably vascular glands or organs. For myself, I may say that I

think the usual accepted theory of the origin of secretions in general will have to be in many respects distinctly modified. Let me not be misunderstood: I am not advocating that *all* secretions are thus formed by hæmetaboly, but I have already grounds for considering that certain are.

It has been usually considered that tissue-cells, apart from macrophages, etc., of endothelial origin, neither ingest nor digest "solid" food; either because they can no longer do so, or because they have ceased, phylogenetically, to make use of this method of nutrition or metabolism. It has been assumed that all their nutrition is effected by means of the digested nutritive material conveyed in solution in the blood-plasma; that this is absorbed by the cells and then built up into living protoplasm; and that this protoplasm, in its turn, can elaborate of itself, in the case of glandular cells, various "secretions" to an extent which is, in some cases, truly amazing¹ when all that is involved in this idea is considered. The hæmoglobin of the normal red corpuscles is regarded as serving the one purpose of carrying oxygen to the tissue-cells.

Now, as soon as I began to study this question, I could see no difficulty whatever in the way of thinking that tissue-cells might, on occasion, exhibit what is a *fundamental property of animal cells*, that, namely, of the ingestion and digestion of solid, organic food; and this is really *the key-idea of the entire subject*. It must never be forgotten that the *tissue-cell* is the unit equivalent to the individual protozoan, *not* the whole metazoan body, which is a congeries of co-ordinated, interdependent units. In other words, we have to deal not with fractions but with multiples of unity (cf. Minchin, "The Protozoa," p. 133). This may be regarded as a truism, but it is one which will bear re-statement; because, in my opinion, a right understanding of the body-economy is *largely dependent upon its realization*. Metchnikoff himself had occasion to point out (l.c.) that even among the metazoa, in both coelenterates and planarians (flat-worms), ingestion and intracellular digestion of food-material is still the normal occurrence. In this connexion, certain interesting observations have been made recently by Reichenow in the course of his work on that part of the life-cycle of a hæmogregarine, *karyolysis*, of lizards, which is undergone in the invertebrate host, in this case a mite. Reichenow finds [9] that the digestion of the blood, the food of the mite, takes place intracellularly, i.e., the corpuscles are first of all actually *ingested* by the intestinal cells and there digested. Moreover, this worker says that the same process takes place in ticks also. It is by no means unlikely, there-

¹ I cannot help thinking that such a questioning thought must have occurred to the minds of others before now; for instance, Jordan and Ferguson (l.c.), in their account of the colloid of the thyroid gland, say (p. 557) that it is "*apparently* formed by the secretory activity of the glandular epithelium" (the italics are mine); as if these authors felt by no means convinced that this is actually the case. Similarly, Hammarsten (*Lehrbuch physiol. Chemie*) writes: ". . . Bestandtheile des sogenannten Sekretes der Drüse, des Kolloides . . ."; again, an expression of disagreement!

fore, that a similar mode of digestion occurs as well in different blood-sucking insects—normally or abnormally; and the bearing of this point upon the nature of the intracellular "*Rickettsia*"-bodies, as found in insects, in the light of my own observations on the residual products of hæmatophagy, requires no emphasis.

With my own mind still imbued with the prevailing view, I did not think, at first, that this mode of behaviour was of normal occurrence in the case of tissue-cells of the higher vertebrates, e.g., mammals. Nevertheless, as I pointed out in my first paper, I saw that such a reversion to a primitive condition was not at all unlikely in abnormal circumstances, as, for instance, under the influence of a violent, irritating stimulus in disease. And, as I have already shown, this mode of behaviour *does* occur, even among epiblastic cells, in many "chlamydozoan" diseases, such as small-pox and hydrophobia; although, *in such cases*, it is apparently unsuccessful as regards the digestive side of the function; in other words, the hæmetaboly is incomplete—partly inhibited, it may be. Since, however, I have found that the metabolization of "solid" organic elements is performed as a normal function, by certain epithelial cells of hypoblastic origin,¹ which no longer constitute a part of the alimentary tract, it is most probable, all things considered, that the same function can be exercised normally also by epithelial cells of various *epiblastic* tissues.

Let me here repeat: there is really nothing new or "revolutionary" implied in this conception; it merely amounts to this, *that a fundamental mode of cell-behaviour thought to be in disuse or in abeyance is in reality not so*. Biologically, there is nothing inherently improbable in this view that the tissue-cells—*homologues of unicellular animals*—not only build up already digested material but also retain the capacity to break down (digest) organized elements.

Once let the rooted idea be eradicated that the red corpuscles serve *only* to bring oxygen to the tissues and it will not be difficult, I think, for our ideas to progress in the above direction. In the first place, what, after all, are the red corpuscles? Little, if anything, more than "sacs" containing hæmoglobin (together with a small quantity of inorganic salts in

¹ Another instance of hæmetaboly by such a cell-type, preceded in this case by hæmatophagy, which I hope to study, is provided by the hepatic cells. I had myself obtained evidence of hæmatophagy here on a considerable scale before seeing the valuable and illuminating papers by Browicz (*Bull. Acad. Cracovie*, especially during 1898-1900). Thanks to this work, which has since been corroborated by Herring and Sutherland-Simpson, hæmatophagic behaviour on the part of the hepatic cells themselves has *already been demonstrated* to occur; but its significance has not hitherto been fully recognized, although Browicz himself suggested that the cells manufacture bile-pigments from the corpuscles taken in. So far as my own observations have led me, I am more inclined tentatively to consider that hæmetaboly by the hepatic cells results in the production of the bile-salts; I think the production of the pigments is rather a function of a particular type of endothelial cell (such as Kupffer's cells), the hæmetaboly here following a slightly different course from that in the case of the ordinary macrophages.

24 *Hæmatophagy and Hæmetaboly as a Function of Tissue-cells*

solution). They are no longer cells—vital individuals; they are, in essence, small masses of a highly complex, organic substance, derived from what was once living protoplasm, enclosed in a delicate skin or membrane.¹ These corpuscles are usually considered to “live” only for a short time—perhaps a matter of days; that is to say, in terms of this view, it must be supposed that the hæmoglobin is no longer capable of attaching to itself oxygen, by reason of some change in its chemical constitution. But there is, I consider, quite another possibility. Do the corpuscles so rapidly become “effete”? Does this definite organic compound (hæmoglobin), circulating in a fairly constant medium (the plasma), so soon become altered in composition, i.e., deteriorate so that it cannot perform its function in connexion with respiration and has to be removed and destroyed? At all events, in any nicely made smear of normal blood, it is extremely difficult to pick out corpuscles which, from any apparent alteration, could be thus regarded; the better the smear and the less the mechanical injury or distortion of the corpuscles, the more nearly uniform in character, staining reaction, etc., these all appear to be.

According to the customary view, these “effete” corpuscles are removed from the circulation and eliminated normally by the macrophages in the various situations in which these are to be found. But I have previously shown that this removal is no mere “purposeless” destruction; their metabolization has a definite result. Certain products of the digestion are utilized in the formation of blood-platelets, and not only the products of corpuscular digestion, it is instructive to remember, but also those of the digestion of true cells, the leucocytes. Since realizing that hæmetaboly by tissue-cells does occur normally, I am inclined to doubt whether the inference usually drawn, and which I myself drew “that, normally, only the worn-out corpuscles will be eaten” can reasonably be regarded as correct. As regards the free nuclei of the immature reds, these are most probably functionally useless and unable to survive, being incomplete cells. But in the case of the specialized corpuscles, or “erythroplastids,” as Americans suitably regard them, I think it may be a different matter. Such corpuscles as have deteriorated, or become in any way injured, will be of course ingested; but it certainly seems to me that the corpuscles may be eaten *not merely* when and because they are “effete,” but because one function of the macrophages is to produce by their metabolization, blood platelets. And the abundant production of fresh corpuscles which is always going on in the hæmatopoietic organs may stand in relation, therefore, I consider, not only, or even mainly, with the replacement of old, worn-out

¹ I am aware, of course, that this is an extreme condition, found only in mammals. But I am emphasizing this particular case in the hope that readers will more readily grasp the feasibility of my thesis. In other vertebrates, however, where the red corpuscles are still true cells, possessing a nucleus, the same conclusion probably holds; namely, that, as regards homologous “secretory” glands and tissues, the red cells are utilized, i.e., metabolized.

ones, but with the replenishment of the stock which is continually being diminished by their utilization for special purposes by different types of tissue-cells (including the macrophages also) in the body. It is possible, indeed, that this relation between blood-elements generally and their utilization may have a deeper significance, bearing upon the counter-balancing of the different capacity and facility for proliferation possessed by different tissue-systems.

A never-ceasing supply of this corpuscular material is continually passing within reach of, often, indeed, practically contiguous to, various types of tissue-cell. And my thesis is that many of them are accustomed to make use of these blood-elements, as a "rich" food supply for *special purposes*. This is, I think, the all-important factor in connexion with the exercise of this function of hæmatophagy and hæmetaboly by the tissue-cells. *The products of digestion do not normally serve, mainly or primarily, for the nutrition, growth and reproduction of the cells themselves.* Cells of any particular tissue are members of a vast community, comprising cells of varied character and diverse function, which are mutually dependent on one another; and the growth and multiplication, or the numerical abundance, of any one cell-series is ordered and regulated in relation to that of the entire community. As a consequence the cells which exercise this mode of behaviour have become specialized and adapted to the production of various substances, valuable, indeed necessary, for the welfare of *the body as a whole*. In the case of the thyroid, for example, it is very doubtful whether, during the formation of the colloid (or other portion of the internal "secretion" of this gland similarly formed) any substance produced by hæmetaboly is in a specific manner assimilated by and incorporated into the protoplasm of the epithelial cells; I mean in any greater degree than it is by the cells of other tissues. At any rate, there is here no evidence of unusual growth or rapidity of multiplication. And, incidentally, I may point out that, on this account, the detection of the hæmetaboly and its results is much less difficult than it is in certain other cases.

Because, in certain cases, I think it will be found that during the progress of hæmetaboly, especially where this is accompanied by hæmatophagy, the digested products or certain of them are, as it were temporarily, assimilated by and incorporated into the cell-protoplasm. In one instance I have already shown that this does happen. The enormous development in size of the megakaryocytes, and their multinucleate condition can undoubtedly be correlated with the assimilation, the almost complete assimilation, except for the residual platelet-granules in the cytoplasm, of the products of hæmetaboly. But my point is this: that such assimilation and incorporation, where it occurs, is only incidental, as it were, to the performance of the specific function of the particular type of cell concerned. The *cell-race* does not participate to any appreciable extent in the advantage which might naturally be expected to accrue from the successful assimilation of this "rich" nutriment, regarding the matter from a

biological standpoint. So far from there being any extensive or unusual reproduction (proliferation) we find the course of the cell life-history to be *profoundly modified*. The megakaryocytes, for instance, do *not* divide in the customary manner, multiplying greatly and overrunning the organs in which they occur; but portions of their cytoplasm only are abstricted, as platelet-cytoplasm, which, lacking any nuclear material, are incapable of continued life and reproduction, and must sooner or later die and disintegrate. In other words, the increased amount of the cell-cytoplasm here does not benefit the cell-race by leading to an increase in the rate of multiplication and spread, but is actually cut off and lost, sacrificed for the use of the body corporate. *And I have reason to think there are other cases of comparable behaviour*; for example, the peculiar processes of pigment-forming cells.

Now, especially to a protozoologist, this remarkable capacity of a cell to break off or lose portions of its protoplasm, which are not themselves living individuals arising by division (e.g., buds), and yet be able to continue its own vital existence, is no ordinary cell-phenomenon to be passed over without thought. On the contrary it implies an extremely specialized condition, which must have some profound meaning; and I suggest it may be an adaptation to *prevent* excessive multiplication and spread of the particular cell-type. It is of interest to recall that Woodcock and Lapage have pointed out [11] that during a characteristic mode of behaviour of the amoeboid flagellate *Cercomonas*, when a small portion of the cytoplasm is left behind adherent to something while the creature continues to progress, the connecting thread, however finely drawn out it may become, *never* breaks!

Having always in mind that this present work is an essential prelude to my chief study, I desire next to ascertain whether epithelial cells of epiblastic origin are also normally capable of hæmatophagy and hæmetaboly, because it is absolutely necessary to know as much as possible about the ordinary life of a normal cell, before it can be hoped to determine in what different manner a malignant cell is behaving. I am proceeding now to study two widely differing examples.

THE MELANIN-PIGMENT OF THE SKIN.

One of these is the formation of melanin-pigment by the skin; the other is the formation of milk by the epithelium of the mammary gland. I will only say a few words here in regard to the former. Thanks to the courtesy of Professor E. H. Starling, who allowed me to make use of the histological collection in his department at my old college, for my preliminary glimpses, I have myself observed the unmistakable occurrence of unaltered red corpuscles in the epithelial cells of normal skin (of the scalp). To me that observation when first I made it, amounted to nothing less than a revelation. Because at that time I was under the impression that hæmato-

phagy and attempted hæmetaboly by epiblastic cells took place only in certain pathological conditions. This observation must have been made several times before; I am astounded that its possible significance has not been realized. To a biologist, *the natural sequel to the ingestion of solid organic material by a cell is digestion*. But the old view of "phagocytosis" has said: here is a corpuscle that has somehow been pushed out of its path and has gone astray; it is being removed and destroyed and that is all that matters. Whereas the new view of hæmatophagy and hæmetaboly says that the corpuscle has been ingested and will be digested—metabolized—with a perfectly definite, specific result. Now tissue-cells are accustomed to obtain their ordinary nutrition from the digested nutriment conveyed by the plasma. What then is the result of the metabolization of this special kind of food (hæmoglobin), by some ferment of nuclear origin, in the case of the epithelium of the skin? It at once seemed to me likely that melanin-pigment was an "excretory" product thereof, comparable to the ferruginous pigment produced by the malarial parasites, and again, to the unassimilated platelet-granules produced by the macrophages; though in all cases, of course, the hæmetaboly is along different lines.

I turned therefore to the existing literature on this subject. And even from the consideration of some of the excellent and well-illustrated accounts already given, I fully expect that I shall find that the pigment is a product of hæmatophagy and hæmetaboly by the epithelial cells. Indeed, certain earlier workers (e.g., Ehrmann, Riehl)¹ *themselves came to the conclusion* that melanin-pigment is formed from the hæmoglobin of the corpuscles. Some of these workers considered, however, that the stellate connective-tissue cells and not the epithelial cells are concerned in the actual pigment-formation. But from more recent work (e.g., that of Jordan, Meirowsky) it is clear that the epithelium does itself produce the pigment (in addition, perhaps, certain connective-tissue cells also?). Further, from the figures of the "vacuoles" in the cells given by various writers (e.g., Halfern, Jarisch, Rössle), I have very little doubt, in the light of my own work, that the red corpuscles can be normally metabolized by the epithelial cells. Moreover, and this is an important point, the pigment-granules are often closely arranged around these "vacuoles" in a most suggestive manner (cf. the figures given by Woodcock and Lodge [12] of the origin of the pigment-grains in immediate relation with the pallid hæmoglobin-masses, in the blood-eating ciliate, *Hæmatophagus*). Several workers have clung persistently to the old idea of nuclear, or nucleolar formation and extrusion of the pigment; but even from their own figures, I cannot see the least indication of such an occurrence. Indeed the tendency at the present day is to look with favour

¹ The references to these and the following papers are all given in Adami [1], or in Jordan and Ferguson [5].

upon von Fürth's recent view that the part played by the nucleus is limited to the production of a ferment which interacts with some non-nuclear substance contained or included in the cytoplasm! This substance may well be the hæmoglobin of ingested corpuscles, from which, as a by-product of its metabolization, the melanin-pigment is formed.

A word or two in conclusion as to the bearing which I consider this subject has upon my principal study. Let me assume in the first place that it becomes established that tissue-cells of many types are accustomed normally to the exercise of hæmetaboly, for particular purposes, being able by means of various specific ferments, to form either largely or entirely from this remarkable compound, hæmoglobin, manifold and widely different substances (coming in the category of secretions or excretions). Let me suggest further, that at times certain "weakly" individual tissue-cells, capable of exercising a hæmetabolic function, pass into a particular condition of physiological depression or exhaustion, in which the cell-equilibrium is disturbed. This can readily be conceived as possible to happen as a result of the action of one of several factors, intrinsic or extrinsic; e.g., long-continued or excessive functional activity, or an unaccustomed stimulus such as chronic irritation or intoxication, respectively. Now let me suggest, finally, that as a *biological response or reaction*—in a strenuous endeavour it may be, to recuperate their vitality¹—such individual cells become able, *instead*, to assimilate this rich nutriment *largely or entirely for their own use*; i.e., *for their own independent and unco-ordinated growth and reproduction*, as if they had reverted somatically to the state of single-celled animals; and indeed that not content merely with red corpuscles, they take to ingesting and digesting also leucocytes and other cells, containing chromatin, with its most complex nucleo-proteids. Remembering, for comparison, the giant-cell characters of the megakaryocytes, *what would be in all probability the inevitable outcome of this abnormal mode of behaviour and alteration in the cell-metabolism?*²

¹ Compare, in this connection, the interesting work of Calkins, Woodruff, and others, on the remarkable vital recuperation of ciliates in a state of physiological depression, which can be effected by changing the nutritive medium.

² As I here indicate, briefly, the view as to the causation of malignancy which is engaging my thoughts, I desire to take this earliest opportunity of acknowledging that I owe the germ of it to Dr. Creighton's book. I first saw this work more than a year ago, at the time when I was studying the megakaryocytes and feeling greatly impressed with these remarkable cells and the potentialities latent in them. I immediately realized that "blood-eating" might very likely be a far more important factor in malignancy than had hitherto been thought to be the case. It may be added that, in the carcinomata I have examined up to the present, there has been no difficulty in finding cells of the cancerous epithelium which contained not only ingested red corpuscles, but also leucocytes, or even in one or two cases other cancer-cells. This fact is, I understand, generally admitted; but little or no attention seems to have been paid thereto.

"The tree that has been planted must be judged by the fruit that it bears."
 (Closing words of a leading article on "A Biological View of the Cancer-cell,"
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MEDICAL ORGANIZATION, WITH SPECIAL REFERENCE TO THE TRANSPORTATION OF WOUNDED, IN OPEN WARFARE.¹

BY COLONEL H. W. GRATTAN, C.B.E., D.S.O.

It was my intention to deal with the transportation of wounded from the point of view of a Division and Corps, but having found it impossible to crowd so important a subject into a short paper, I propose to confine my remarks chiefly to the medical organization and administration of the medical service of a division.

This paper is based on three years' experience on the Western Front as an Ambulance Commander, A.D.M.S. of a Division and D.D.M.S. of an Army Corps, and includes service in four different armies on many fronts extending from Ypres to St. Quentin where at one period the Sixth Division, of which I was A.D.M.S., held the post of honour on the right of the British Army next the French during our advance in the autumn of 1918.

During trench warfare, which is in reality siege warfare, the transportation of wounded does not present the variety of problems for solution as in a war of movement, where, during operations, the medical situation might change every hour or half hour. I would lay stress on the importance to all administrative medical officers of developing the faculty of anticipating the nature of medical problems in the field, and taking steps to cope with them before they actually occur; with the result that either the undesirable situation does not develop or if it does materialize, it does so in a modified form, and measures to combat it being in readiness are switched on without delay, so that there is no check to the evacuation of the wounded.

In laying stress on the importance of foresight, I do not refer to such routine matters as an adequate supply of stretchers, blankets, waterproof sheets, dressings, and means for reinforcing bearer personnel; but I refer to a general review of an area before a battle with the aid of a map, or better still, by reconnaissance of the ground, and with a knowledge of the Divisional Commander's intentions, to visualize the most likely outstanding medical difficulties as regards the evacuation of the wounded. In one instance it was fairly obvious that the evacuation of stretcher cases would be difficult as there was no road leading in the direction of our attack, all the roads running more or less at right angles to the line of our advance. Consequently the location of advanced dressing stations in suitable situations presented some difficulty, but this was overcome by locating them in

¹ Reprinted from the *Proceedings of the Royal Society of Medicine*, 1922, vol. xv (War Section), pp. 6-13. Paper read at the War Section, December 12, 1921.

a town (Le Cateau) outside the divisional area where the majority of roads converged. On another occasion the problem for special consideration was the evacuation of walking wounded owing to the extent of the front held, paucity of motor lorries for walking wounded and the inconvenient route followed by the light railway. The problem was successfully dealt with by utilizing the light railway up to a point nearest to the C.W.W.S. and installing a "ferry" of lorries between that point and the Corps W.W.S., a distance of four miles.

Again, when personnel, equipment, or other forms of medical assistance are required in the field, they are wanted at once, there must be no delay or the evacuation of the wounded may be delayed. By this I mean that the medical personnel should always know the location of the nearest "échelon" of reserves, which can be drawn on in the event of their own reserves becoming dangerously depleted.

(I) When an A.D.M.S. first takes over his duties he may not fully realize the importance of *co-operation* and *co-ordination* with other members of the divisional staff, and with the officers commanding certain units of divisional troops, or how success in perfecting arrangements for the succour of the wounded is largely dependent on the liaison of the medical branch with other branches at divisional headquarters. The more this principle of liaison is encouraged and developed the higher the degree of medical efficiency attained, with consequent benefit to the wounded soldier and, incidentally, a lightening of the task of the Administrative Medical Officer.

In reality, divisional and corps headquarters consist of a number of specialists who control and deal with a number of different questions nearly all of which have a direct or indirect bearing on the succour of the wounded in battle. With regard to the tactical disposition of field ambulances the General Staff are interested in the position of main dressing stations, chiefly from the point of view of the possibility of obstruction to the passage of troops, ammunition and supplies by the movements of motor ambulances. In selecting sites for advanced dressing stations in open warfare we were given a free hand, but in trench warfare no new constructional work would be undertaken without conferring with the brigadier concerned and the General Staff.

The General Staff also deals with questions relating to Army Signals and controls the issue of field telephones and their location, with special reference to the possibility of the enemy obtaining information by tapping instruments in an unduly advanced position. The divisional main dressing station was invariably on the telephone and one of the advanced dressing stations as a rule whenever field telephones were in use. The issue of maps is also the province of the General Staff, and because it was considered that the authorized allotment to field ambulances was meagre, we never rested until we obtained a more liberal supply.

The Intelligence branch is also controlled by the General Staff and

arrangements were made for the Medical branch to be kept informed of the location of all enemy medical posts which might be utilized as we advanced. This information was obtained from aërial photographs and from interviews with recently captured prisoners. The allotment of fighting troops as bearers in case of necessity was also arranged by the General Staff.

Misunderstandings are nearly always due to faults on both sides. Such a misunderstanding once occurred between the Medical branch and the General Staff when I was A.D.M.S. of a division. When I first took over medical charge of a division the General Staff rather regarded the medical arrangements as automatic, and did not realize how important it was for me to have information regarding pending operations at the earliest possible moment. When once the staff comprehended my difficulties everything worked smoothly.

There is no time to explain in detail how co-operation with all the other branches helped to simplify many medical problems—but my policy was to invoke the aid of all branches, as the wounded have a claim to help and sympathy from all.

The *extent of the front held by the division* varied. In March, 1917, the division took over a front of 11,000 yards (over six miles) from the double-crassier in Loos, to the Hulluch-Hohenzollern sector. At this time, however, the division was reinforced by a fourth brigade. At the battle of Cambrai (November, 1917), the division attacked on a front of 2,600 yards, while at the opening of the German offensive in March, 1918, the division was in the line, N.E. of Bapaume on a front of 4,500 yards. The depth of the area and distance of Divisional Headquarters from the front line varied from $3\frac{1}{2}$ to 6 or 7 miles.

(II) *The Field Ambulance.*—As the duties of ambulance commanders are difficult, trying, and dangerous, my policy as an A.D.M.S. was to try to lighten their burden, and to be able to help them at once, with something more substantial than advice when difficulties arose. Knowledge that the A.D.M.S. can help in case of urgent necessity is a source of the greatest relief to ambulance commanders, and enables them to concentrate on and speedily overcome local difficulties. One of the special troubles was the constant unavoidable changes in personnel—especially of medical officers—to replace casualties among regimental medical officers, or in response to orders to reinforce C.C.Ss.

It was realized that a high standard of efficiency was best attained by decentralizing the various duties in the unit in every possible way, in order to leave the ambulance commander free to concentrate on the weak points in his unit and to give him time to think out methods of improving the existing plans of evacuation. Our aim was to organize the ambulances in such a way that the duties were carried out as well, or almost as well, when the Commanding Officer was absent.

With regard to their special duties ambulance commanders are

specialists in evacuation from the forward area, and the duties include the perfecting of measures for combating shock and collapse, aiming to get the patient to the C.C.S. within six hours of being wounded, and at the same time taking every possible precaution to minimize the evil effects of shock.

Special stress should be laid on the importance of encouraging and developing initiative in all ranks of the medical service.

THE FIELD AMBULANCE.

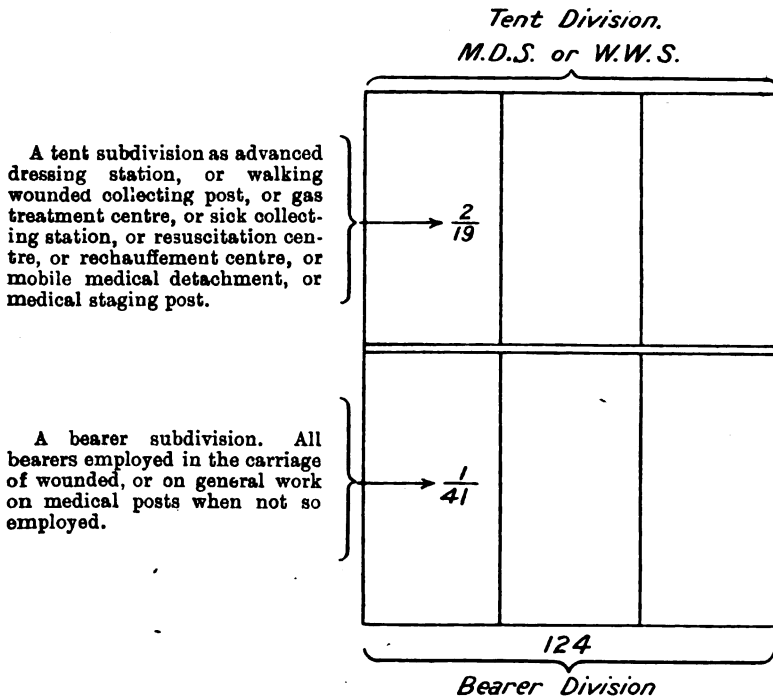


FIG. 1.—To illustrate the adaptability and flexibility of the field ambulance. The figures $\frac{2}{19}$ and $\frac{1}{41}$ denote the personnel of a tent subdivision and bearer subdivision respectively, i.e., 2 Officers and 19 other ranks, and 1 Officer and 41 other ranks. Normally a complete tent division would be employed as a M.D.S., while a second tent division would constitute the W.W.S. with two subdivisions, its third tent subdivision forming the advanced W.W. Collecting Post.

ALLOTMENT OF DUTIES TO FIELD AMBULANCES.

Among the important duties are included (a) the collection, treatment, and evacuation of lying, and walking wounded and "gassed" cases; (b) the administration of main and advanced dressing stations, walking wounded stations, and collecting posts; and (c) the control of motor and horse ambulances.

The A.D.M.S. has to decide how these various duties can be most efficiently carried out, in view of the special conditions which obtain at

the time, and after I have dealt with the handling of the bearer divisions, I will show in the form of a diagram five different methods of allotting duties to field ambulance commanders.

The Bearer Division.—The efficient handling of the bearer divisions, although it often entails working under most dangerous conditions, is simpler than the management of the tent divisions. The bearer division is a mobile formation, and its duties and dispositions are not altered in any way whether Corps Medical Institutions¹ are established or not.

The two principal ways of controlling the three bearer divisions were: either to detail one ambulance commander to be in charge of the evacuation from the forward area and controlling all three bearer divisions: or to divide the responsibility between two ambulance commanders, placing one in charge of the evacuation from two brigades, and making the other responsible for the remaining brigade.

In every case each bearer division was commanded by an R.A.M.C. bearer officer known as the brigade bearer officer who worked under the orders of the ambulance commander concerned. Under these arrangements there were usually two officers available, including an ambulance commander in case of necessity, to direct and supervise the evacuation of casualties from any one brigade.

In deciding whether to entrust the whole of the forward evacuation to one ambulance commander or to two, the following points would be considered: If the division was on a narrow front of about 3,000 yards, with the initiative in our hands and one main channel of evacuation—then the best and most economical method was to employ only *one* ambulance commander to control the three bearer divisions. On the other hand, if the initiative was in the hands of the enemy, or if the tactical situation from a medical point of view was a difficult one, or if the front held by the division was 3,500 yards or more, or if there were two distinct channels of evacuation—one on either flank—then the best results were obtained by dividing this duty between *two* ambulance commanders.

The work of the bearers is the most important duty of the field ambulance, and however high the standard of surgical aid is at the advanced and main dressing stations, it cannot compensate for or neutralize the evil effects which result from failure on the part of the bearers to bring the patients back at the earliest possible moment.

Efficient bearer work entails: (a) Adequate means for keeping in constant touch with the regimental medical detachments; (b) reserves of personnel and equipment so placed that they are available immediately when required.

The weakest link in the chain of the bearer organization is at the regimental aid post, where a break or interruption in the evacuation of

¹ Corps main dressing stations, walking wounded stations, gas treatment centres, and sick collecting stations.

stretcher cases is most likely to occur, and in order to maintain communication with the constantly shifting regimental aid posts, the following measures were adopted: From four to eight R.A.M.C. bearers were placed under the control of the regimental medical officer, and were attached to the regimental aid post, and acted as bearers, guides, and runners. If we liken the regimental stretcher bearers to the body of a kite, these four to eight R.A.M.C. bearers form the tail of the kite—the tail being inseparable from the body.

When the regimental aid post was moved forward and established in a new position, a squad of the attached R.A.M.C. bearers would take a case back to the former regimental aid post, which in turn became a relay post, and there the case would be handed over; and other bearers would proceed forward to the new regimental aid post, being guided by one or more of the R.A.M.C. bearers attached to it. The service of these guides was essential, especially during operations in open warfare at night.

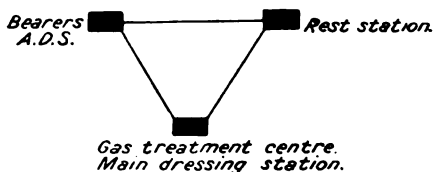
In addition, the brigade bearer officer, who was also a medical liaison officer was attached to and lived at brigade headquarters; he was not, however, under the orders of the brigade, but was under the orders and control of the field ambulance commander concerned. This arrangement worked admirably in practice. The brigade bearer and liaison officer was in direct communication with battalion headquarters, and he received information as soon as it was received by the brigade—that is, before divisional headquarters and the A.D.M.S. were informed. In addition, his duties included constant visits to the regimental aid posts; keeping a strict watch over the supply of blankets and stretchers; sending back word through the car-loading post for any requirements, and always watching for a favourable opportunity to move the car-loading post to a more advanced position, in order to lighten the work of the bearers by substituting motor transport for hand carriage or wheeled stretcher as early as possible.

The general arrangement for the supply and dispositions of reserves of stretchers, blankets and bearer personnel during a battle is best shown by diagrams. A constant stream forward of stretchers and blankets must be maintained to take the place of those in use. The supply of this equipment has to be arranged on a definite plan, so that the regimental medical officer knows where he can obtain the necessary articles without delay.

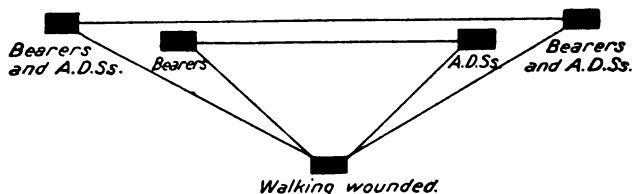
If the A.D.M.S. holds up a portion of the bearers as a reserve, it makes it difficult for the ambulance commander in charge of evacuation of stretcher cases to arrange for reliefs and much needed rest, without which the system of evacuation would collapse. The best results were obtained by handing over all the bearers to the ambulance commander concerned, and as A.D.M.S. I held, as a reserve, 100 to 150 fighting troops, who were located as a rule in the vicinity of one of the field ambulance headquarters, the site being determined according to circumstances.

ALLOTMENT OF DUTIES AMBULANCE COMMANDERS.

TRENCH WARFARE.



OPEN WARFARE WITH CORPS MEDICAL INSTITUTIONS.



OPEN WARFARE WITHOUT CORPS MEDICAL INSTITUTIONS.

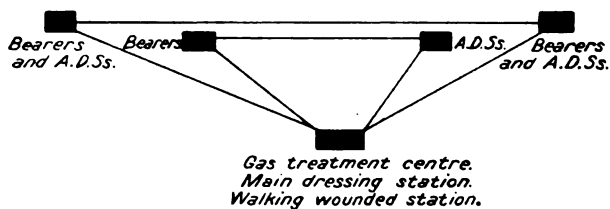


FIG. 2.—To illustrate different methods of allotting duties to ambulance commanders. ■ = an ambulance commander. Trench warfare: One ambulance commander controls the three bearer divisions and administers the advanced dressing stations (tent subdivisions). The rest station is organized from one complete tent division, and the gas treatment centre and main dressing station from the remaining tent division. In open warfare the rest station was closed and the tent division thus set free formed the divisional walking wounded station, and walking wounded collecting posts. The triangles with broad and narrow bases illustrate the arrangements on a broad and narrow front respectively. Corps medical institutions were staffed and equipped by one complete tent division including an ambulance commander from each of the two divisions in the line. This necessitated some adjustment of medical duties in the division, e.g., the second in command of a field ambulance taking the place of the ambulance commander lent to the Corps. When Corps medical institutions were not in use the duties of evacuating stretcher cases from the R.A.P.s to the M.D.S. (when the division was on a broad front) would be allotted to two ambulance commanders, the third ambulance commander being concerned with the administration of the gas treatment centre, M.D.S. and the W.W. Station. A modification of this arrangement would be to allot the duties in connexion with walking wounded to the second in command of the field ambulance that was evacuating stretcher cases from one only of the three brigades.

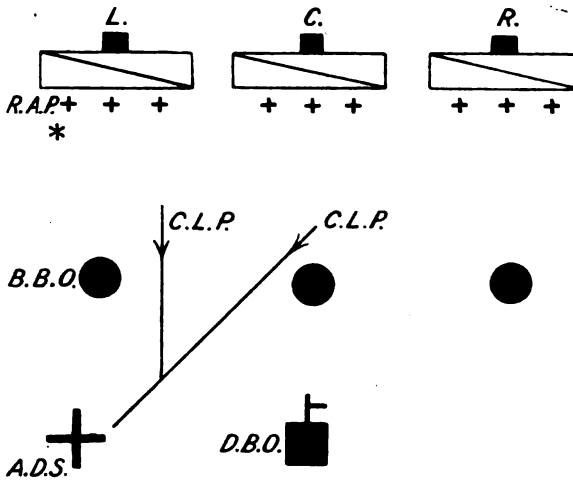


BEARERS.

FIG. 3.—To illustrate the handling of the bearer divisions on a three brigade front. Legend :

 = D.B.O., the divisional bearer officer (ambulance commander) in control of three bearer divisions, each of which is commanded by a "brigade" bearer officer. C.L.P. = Car loading post, which works in front of the A.D.S.  = B.B.O., brigade bearer officer.

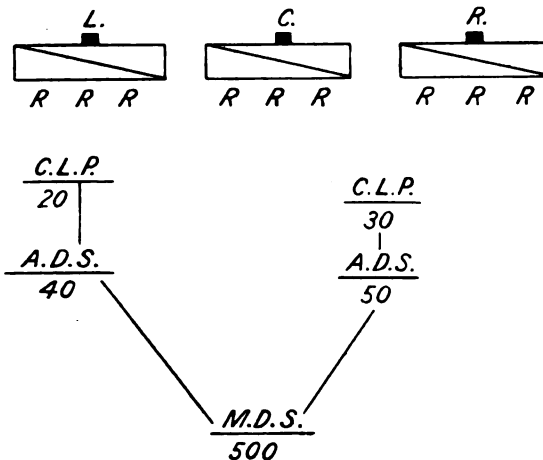
STRETCHERS.

FIG. 4.—To illustrate the general scheme for the supply of stretchers on a three brigade front. R = relay post. The first relay post is at the R.A.P. The letter R in the diagram denotes the position of the second relay post where the most forward reserve of stretchers is maintained. In some instances the second relay post might serve two battalions instead of one. The remaining letters and figures explain themselves. C.L.P. = car loading post, where a reserve of twenty to thirty stretchers would be maintained, and which would be moved forward in relays in the empty ambulance when the C.L.P. took up a more advanced position.

* In 1917 the four battalions of a brigade were reduced to three.

(III) Before active operations the following conferences were usually held: One between the divisional commander and his staff, another between the D.D.M.S. of the corps and the A.Ds.M.S. of divisions, and another between the A.D.M.S. and field ambulance commanders and seconds in command.

At the divisional commanders' conferences before an attack on Lens in 1917, a plasticine model to scale of the field of operations was shown, and it was of the greatest assistance to those concerned to visualize the position of our objectives and the nature of the obstacles to be overcome, the various lines of trenches, the belts of wire, the contours, and the position of the roads or tracks.

In open warfare, however, it was never possible to have models of this description and we had to be content with maps. At these conferences the A.D.M.S. would learn what our objectives were; the boundaries of our area before and after the advance; where the greatest resistance would be expected, and consequently the heaviest casualties; what roads or tracks would be used by the artillery and infantry respectively; what roads it was the intention of the divisional commander to keep open as far as possible with all available labour; the situation of craters or other obstructions to transport.

At this conference the A.D.M.S. would decide with the divisional commander's approval what road would constitute the main channel of evacuation; and when this important point had been settled, the approximate sites of advanced dressing stations could be selected, and in this way the foundations of the medical arrangements laid. During the autumn of 1918 when our attacks succeeded one another at very short intervals (on some occasions without any interval at all) conferences were not always held and the A.D.M.S. would obtain the necessary information from the General Staff.

In connexion with the question of written orders the usual sequence in which orders and instructions were issued before operations was as follows:

First, a warning order issued by the General Staff, then an R.A.M.C. or medical warning order issued by the A.D.M.S. to field ambulance commanders only, then the divisional operation order issued by the General Staff; on receipt of which the A.D.M.S. would issue the R.A.M.C. operation order to field ambulance commanders, copies being sent for information to G., Q., Brigade Headquarters, the D.D.M.S. of the corps, A.D.M.S. of divisions on either flank, the O.C. M.A.C., and when circumstances demanded to the divisional supply officer and the D.A.P.M.

Simultaneously, the A.D.M.S. would draw up a concise draft of the medical arrangements for insertion in divisional administrative instructions which were issued by the A.Q.M.G.

Before discussing the scheme of medical arrangements in open warfare I must refer to two points, the importance of which must be realized by

the administrative medical officer, otherwise the medical units under his command may be the means of imperilling the success of the whole military operations.

They are secrecy and the maintenance of a high standard of traffic and march discipline. Speaking as a non-combatant it appeared to me that military success in open warfare depended more on efficient traffic and march discipline than on any other factors; without them ammunition and supplies cannot reach the troops and the heavy artillery cannot

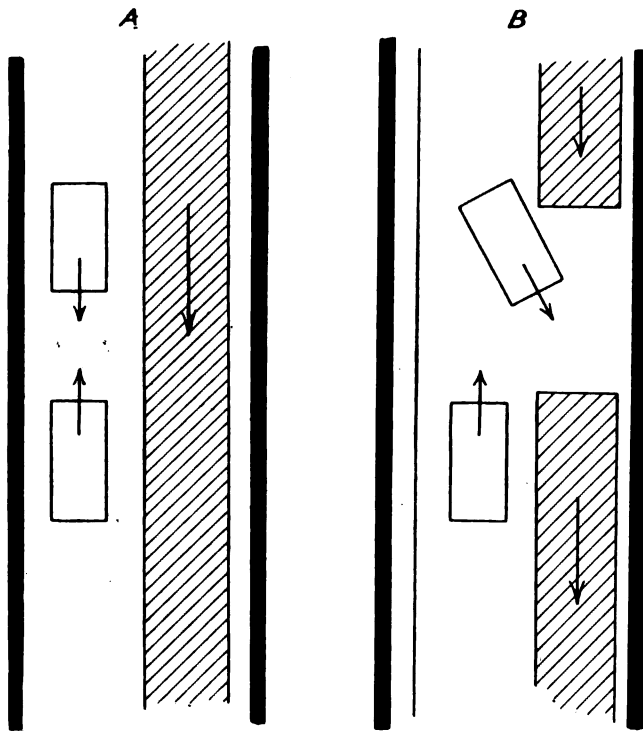


FIG. 5.—To illustrate the necessity of march discipline—maintaining a space between every twenty vehicles of a column on the move. The thick lines represent the sides of two roads. A shows how a block in the traffic commences when no such interval is kept. B shows how a block is obviated by the space kept in the column.

advance, and incidentally, the transportation of wounded becomes a very serious problem. March discipline has been described as the ceremonial of war—interpreted in medical terms it meant, never under any circumstances to allow the field ambulance transport to be overloaded, as an overloaded wagon may break down and become the starting point of a serious block in the traffic.

As regards traffic discipline it meant not only complying with the instructions laid down for traffic on the various routes, but it also meant

strict compliance with the order to keep an interval of so many yards between every twenty vehicles when the transport of a column was on the line of march.

The personnel of the field ambulances grasped the importance of these principles so well that on no single occasion did I hear any complaint on this score. The practical outcome as regards the wounded was that in open warfare we were given a free hand as regards the position of medical posts including main dressing stations, where the movements of the divisional motor ambulances and the M.A.C. might be the cause of serious trouble, unless suitable arrangements for traffic had been made beforehand, including a separate entrance and exit to the main dressing station and ample space for parking ambulances.

I may mention that I have seen, in the course of operations, a first-class road for "two-way" traffic entirely blocked by wheeled transport for a distance of over seven miles. This unfortunate incident occurred in a column of one of our allies and I understood that the road remained blocked for about twenty-four hours.

(IV) (a) We will now consider the medical arrangements in an *attack with a subsequent advance of some miles*. Experience showed that these conditions were the least difficult in which to organize satisfactory medical arrangements, in spite of the following complications: (1) The communications having become lengthened; (2) the size of the divisional area having increased considerably; (3) the blowing-up or obstruction of roads.

The reasons why these conditions were less difficult to deal with than those involved in a hostile attack or counter attack, were as follows:—

(1) The initiative being in our hands, the A.D.M.S. made his plans, and informed all concerned what those plans were, with due regard to secrecy, and he carried them out resolutely to the end.

(2) The difficulties due to lengthened communications were neutralized by the advantages accruing from motor transport, both for the evacuation of wounded and for bringing forward medical personnel and equipment, and also for dealing with the problem of obstructions and defects in roads, as R.E. personnel, material and mechanical devices for removing obstructions can be brought up with a minimum of delay.

It is most important to draw up the broad outlines of your scheme of transportation and to decide what is to be your main channel of evacuation during the advance, and after the objectives have been taken, bearing in mind that it economizes personnel to have *one* divisional route of evacuation, although under certain circumstances it may be necessary to have two.

Knowledge of the situation of this route or channel will enable those interested to grasp at once the foundation on which the scheme for rendering medical aid is based, and bearer officers and regimental medical officers can formulate and co-ordinate their plans, with the object of bringing the stretcher cases to a series of definite points, if possible in a direction towards the main channel of evacuation.

In an attack, arrangements would be made for three advanced dressing stations, staffed and equipped by three tent subdivisions. The first would be open and working before the attack, the second would be in readiness to advance immediately when ordered by the A.D.M.S., while the third would be held in reserve. The administration and handling of the advanced dressing stations would be allotted to *B* ambulance commander who would also control the fifteen divisional motor ambulances, less the six Ford cars which are apportioned to the three bearer divisions under the control of *A* ambulance commander. The arrangements for dealing with the walking wounded would be controlled by the third or *C* field ambulance commander with a complete tent division, all the horsed ambulances, and half-a-dozen motor lorries usually provided by the Corps—this ambulance commander would establish a divisional walking wounded station with two tent subdivisions, his third subdivision being utilized as a collecting post, which is the counterpart of the A.D.S. for stretcher cases.

As the troops advance the collecting post is expanded into a new divisional walking wounded station and a more advanced collecting post established by one of the three tent subdivisions allotted for this purpose.

(b) *The Hostile Counter-attack.*—My conception of the medical arrangements necessary in the event of a counter-attack consisted in the closing of the most forward advanced dressing station, in the opening of another in a position 1,000 yards or so farther back, and also in the moving up of more bearers.

Additional arrangements which proved to be necessary on one occasion, involved the establishment of an entirely new route of evacuation at right angles to our original main channel and five miles distant from and parallel with our front. Another unforeseen complication occurred, namely, the fact that the transport of the field ambulance on the right narrowly escaped capture. We were all taken unawares as the counter-attack came in the wrong place and on the wrong day.

(c) Only brief reference can be made to the medical problems that have to be considered during an intensive and continued *hostile attack* like the German offensive in the spring of 1918. The administration of the medical services under these conditions was very difficult. From the point of view of a division and corps it is *the* situation in which a medical catastrophe is most likely to occur. The circumstances are difficult for many obvious reasons, for when the initiative is in the hands of the enemy, we do not know what his plans and objectives are. In my experience the special medical problem for consideration was the transportation of stretcher cases to the C.C.S. from the M.D.S. or A.D.S. and the calamity to be guarded against was the capture of numbers of lying cases. This we were successful in avoiding, with the exception that one advanced dressing station was captured. The paucity of information regarding the military situation and the hindrance to communication by signal or otherwise owing to acts of the enemy all added to our difficulties. In addition,

motor lorries that were usually allotted for the conveyance of walking wounded were urgently required for other purposes; there was the likelihood that fighting troops as additional bearers might not be forthcoming, and the "fog" of war added to the general embarrassment. The general principle in handling the medical units of a division in these circumstances is to establish a series of advanced dressing stations and walking wounded collecting posts in échelon, and to inform ambulance commanders that they must delegate the responsibility of vacating these advanced posts, and withdrawing to the next échelon, to the officers in charge of the post.

The main dressing station must similarly be organized in échelon with one tent subdivision ready to open up and carry on in the new position while the remaining tent subdivisions close and prepare to withdraw. As the work of the bearers presents special difficulties the task of evacuation from the forward area should be handed over to two ambulance commanders. Owing to the difficulty of communications, it is of special importance for either the A.D.M.S. or the D.A.D.M.S. to make frequent visits to the various posts, in order to keep in touch with the needs of the constantly changing situation.

For want of time I am unable to discuss the rôle of an A.D.M.S. during a battle, or to deal with the organization of Corps Medical Institutions, relative to their advantages and disadvantages, and the circumstances which indicate or contra-indicate their employment.

I am indebted to Mr. G. Davison for kindly drawing the diagrams.

REFERENCE.

MARDEN. "A Short History of the Sixth Division," 1920.

SOME DATA ON THE BIO-AERATION OF SEWAGE.

BY CAPTAIN H. N STAFFORD, M.C.

AND

CAPTAIN A. R. WARD.

Army School of Hygiene.

INTRODUCTORY.

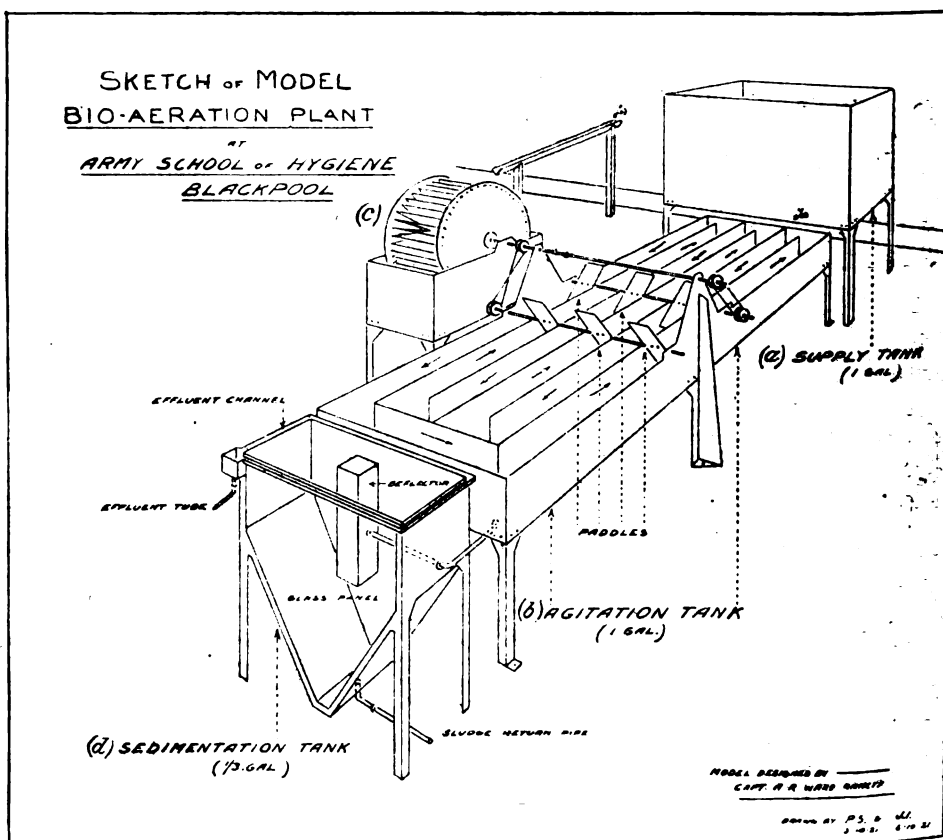
THE following data have been obtained in the course of an investigation into the bacteriological and chemical changes in sewage when treated by bio-aeration. Some months ago, Lothian and Ward described briefly (JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, June, 1921) the latest plant erected at Sheffield to deal with sewage by this modern method. After twelve months working this plant has proved so successful that plans have been submitted to the Sheffield Corporation to deal with the whole of the sewage. The method has thus obviously attained a status which demands precise knowledge of the changes involved, and in order to commence investigations a miniature plant, designed by one of us (A. R. W.) was constructed at Blackpool six months ago. This plant is illustrated in the diagram (drawn by Captain J. Inglis, O.B.E., R.A.M.C.T.F.), and has been found extremely satisfactory for experimental purposes, dealing with a gallon of sewage at a time, and propelled by water power. It was constructed as far as possible to scale, was based on the principles involved in the plant at Sheffield, and comprised the following (*vide* diagram):—

- (a) Supply tank, fitted with an agitator to prevent deposition of solids ;
- (b) agitation tank, divided into six channels, each containing a paddle operated by (a) ; (c) water wheel ; (d) sedimentation tank of the "magnetite type," to facilitate the withdrawal of sludge.

PREPARATION OF ACTIVATED SLUDGE.

Sewage sludge was collected at the screening plant of the Blackpool Corporation Disposal Works, from which source all sewage samples were obtained throughout the experiments, and a mixture of sludge and sewage containing five per cent by volume of the former was agitated by paddles in the agitation tank (*vide* diagram), until a definite brownish tinge was obtained, when the sludge was allowed to settle, the supernatant liquor drawn off and a further quantity of sludge and sewage added and again agitated. Sixteen days agitation were required to produce the necessary volume of sludge, i.e., twenty-five per cent. by volume after standing one hour. By commencing with five per cent of the fully activated sludge, however, instead of the crude sewage sludge, only about five days were required to produce the same volume of sludge as above, thus shortening the agitation period to a third of the time.

The process of purification was carried out as follows: Samples of sewage were added to the supply tank and admitted to the agitation tank at a constant rate controlled by a screw-clip, to allow a flow of one gallon every eight hours to pass through the agitation tank, which contained the requisite amount of sludge, i.e., twenty-five per cent by volume. The mixture of sludge and sewage was kept agitated by means of the paddles actuated by a water wheel. The resultant effluent passes out to the sedimentation tank, through a deflector, to the bottom of the tank



where the deposition of sludge is effected, and the clear supernatant liquor passes over the sides of the tank into collecting channels connected with a small exit tube.

The settled sludge was drawn off by means of a vacuum pump, and re-admitted each day to the agitation tank, thus maintaining the twenty-five per cent by volume.

After working for some time, it was found impracticable to carry out bacteriological experiments on the continuous-flow system owing to

clogging of the small orifice through which the sewage passes to the agitation tank. It was therefore decided to disconnect the supply and sedimentation tanks and work on the "fill-and-draw" system.

Samples of sewage were therefore poured direct into the agitation tank. The paddles were then set in motion and allowed to agitate the sewage and sludge for twenty-four hours. Samples were taken at intervals, the sludge allowed to settle, and the supernatant liquor submitted to chemical and bacteriological examination.

CHEMICAL CHANGES.

In the course of a short time the effluent was found to satisfy fully the chemical standards laid down by the Royal Commission on Sewage Disposal, as shown in the following table which summarizes the findings of very numerous chemical analyses (figures throughout are expressed in parts per 100,000) :—

Nature of sample	Crude sewage			Effluent (plant working on the continuous-flow method)			Effluent (plant working on the fill-and-draw method)		
	Strongest	Average	Weakest	Worst	Average	Best	Worst	Average	Best
Oxygen absorbed in 4 hours at 80° F.	24.00	11.34	4.56	0.91	0.86	0.66	1.66	1.18	0.84
Chlorides (as Cl)	83.0	92.0	142.0	260	365	540	74	251	40
Ammonia (as NH_3), free and saline	6.960	5.623	1.992	4.156	2.655	4.732	4.120	2.907	1.520
Ammonia, albuminoid	3.720	1.504	1.060	0.304	0.299	0.142	0.440	0.281	0.288
Nitrites (as N) ..	..	..	..	0.05	0.05	0.10	0.10	0.10	0.10
Nitrates (as N) ..	..	..	..	0.17	0.43	0.62	0.94	1.08	0.78
Dissolved oxygen taken up in 24 hours at 65° F.	..	..	..	0.66	0.45	0.35	0.84	0.44	0.33

These figures—from a one gallon capacity model—may be compared with those of Haworth at Sheffield (*vide* Paper read at Conference of Institute of Municipal Engineers, 1921), and of Ardern (*Journ. Chem. Ind.*, 1920), viz. (averages) :—

	Sheffield Plant, continuous flow and agitation		Chorlton Plant, continuous flow with maximum compressed air supply admitted by diffusers (dry weather)	
	Sewage	Effluent	Sewage	Effluent
Suspended solids	77.42	3.00	18.0	3
Oxygen absorbed in 4 hours ..	13.93	1.39	3.53	0.66
Free and saline ammonia ..	5.09	4.41	3.00	1.53
Albuminoid ammonia	1.22	0.91	0.59	0.10
Nitric nitrogen .. ..	..	0.10	..	..
NO_2 and NO_3 (as NH_3) ..	..	..	..	0.64
Dissolved oxygen taken up in 5 days at 65° F.	..	1.30	..	0.93

It was found that the volume capable of being satisfactorily treated by the experimental plant was 375 gallons per cubic yard per day. (The cubic yard in existing methods refers, of course, to filter beds; in bio-aeration plant it implies agitation tankage). This is a figure larger than any obtained in existing types of plants, and explains, on economic grounds, the preference which municipal authorities must have for bio-aeration plants.

BACTERIAL CHANGES.

Bacteriologically, assays were made of the supernatant liquor after settlement of the sewage-cum-sludge, five minutes after addition of the crude sewage; these figures (very much less than those of crude sewage) were taken for present purposes as the base line, and the organism content of the effluent after varying periods of treatment compared, to determine the extent of reduction of organisms. Attempts were also made, at first, to determine the reduction factor of *B. coli communis per se*, but it was found more feasible to include for the present investigation all its immediate cogeners. Occasional more careful examinations, employing "flaginac" and the Voges-Proskauer and methyl red tests, showed the great majority of lactose fermenters to be true *B. coli* of the human type (MR +, VP -). The decimal mode of dilution and calculation was used throughout, *B. coli* being estimated on litmus-lactose-bile-salt-agar, and total organisms on agar.

The following table summarizes the bacterial findings:—

Nature of sample : crude sewage and activated sludge.

	Period of agitation—	5 mins.		6 hrs.		24 hrs.
Total number of bacteria in 1 c.c. of liquor after settlement		194,000	..	50,000	..	26,300
Percentage reduction	74.0	..	86.0
Number of <i>B. coli</i> (or closely-allied forms) in 1 c.c.		70,000	..	5,900	..	1,840
Percentage reduction	92.0	..	97.0

It will be seen that while there is an appreciable reduction in bacteria, the reduction factor does not compare with that quoted by other workers. Courmont and Rochaix, for example (*Comptes Rendus*, 1920), found a reduction from 202,500,000 per cubic centimetre to some 60,000 per cubic centimetre. The reason is that in our experiments the bacterial content of crude sewage was not taken as the base line, but, as already stated, and for convenience, the supernatant fluid settled after five minutes agitation with sludge. It will be recalled that, at once—on the addition of sewage to activated sludge—there is a flocculation of colloidal matters, so that even five minutes admixture allows a vast proportion of contained matters to be carried down on settlement, leaving a fraction only in the supernatant liquor. We use the latter throughout for comparison. The final effluent, of course, compares truly with that of large size plants and with models of other workers, and our figures compare quite fairly with those

of the French workers mentioned above, and also with Ardern's figures, some 20,000 per cubic centimetre.

The effluent, then, is far from sterile. If actual sterility is desired, no advantage is gained by prolonging the agitation, and chemical means must be used. We have found that the administration of four parts per million of chlorine, from bleaching powder, suffices to sterilize the effluent in half an hour, an amount and method easily applicable when, for special reasons, sterilization is wanted. This compares favourably with Houston's finding, that *ordinary* sewage effluents can be sterilized by one to ten parts per 100,000 of "chloros" (sodium hypochlorite), i.e., at least ten parts per million (Royal Sewage Commission, Fifth Report, Appendix 4).

The biology of the activated sludge is complex, and it is far from clear which organisms are most efficient in purifying the liquor. Courmont and Rochaix found only seven aerobic species of bacteria in their effluent (i.e., absence of putrefactive anaerobes), of which five were chromogenic, and no *B. coli* or other known pathogenic organisms. *B. subtilis* was one of them. Five were direct denitrifiers, as tested on KNO_3 . In our plant we never secured complete elimination of *B. coli* and indeed have come to regard it as playing a very important part in the process.

Sir A. C. Houston, who has done so much work on water and sewage, had, we gather, an idea that in sewage treatment by ordinary biological filters, *B. coli* plays the part of a passenger only; so, at least, we gather from his experiments, detailed in an article on p. 272, app. IV, Fifth Report of the Royal Sewage Commission, which tended to show that even with a sterile sewage, chemical purification is effected by the filter flora, with a gradual disappearance of *B. coli* washed out in the effluent. After receiving very kind advice from him, we attempted to prove this thesis, and to determine how far purification is dependent on the *fresh* organisms introduced to the sludge with every filling of sewage, by treating sterilized sewage in our bio-aeration model. Sterilization was effected by boiling. The chemical and bacteriological results were as follows:—

Sewage sterilized by boiling.

Effluent		Period of agitation—	5 mins.	6 hrs.	24 hrs.
Oxygen absorbed in 4 hours at 80° F.	1.39	Total number of bacteria in 1 c.c. of liquor after settlement	75,000	7,500	6,250
Chlorides (as Cl)	.. 50.00	Percentage reduction	..	90.0	91.0
Nitrites (as N)	.. 0.05	Number of <i>B. coli</i> (or closely allied forms in 1 c.c.)	3,100	4,100	730
Nitrates (as N)	.. 0.10	Percentage reduction	..	32.3	76.5
Volume treated per cubic yard, in gallons	187.00			(increase)	

It will be seen that the chemical changes—nitrification—appears to be definitely retarded, only half volumes of sewage being adequately dealt with by eight hours agitation; while bacteriologically there is a definite increase of *B. coli* at first, followed later by a reduction. This seemed to suggest a correlation between the "passenger" organisms and the chemical change,

and an attempt on the part of the coli in the sludge to multiply at first in order to play their usual part.

Using the same sterilized sewage, to which, however, measured numbers of typho-coli group organisms had been added before introduction into the tank, it was found that the results were as follows:—

Effluent	Sterilized sewage		{ to which <i>B. coli</i> - to which <i>B. typhosus</i> was added was added			
Oxygen absorbed in 4 hours at 80° F.	..	..	0.84	..	0.65	..
Chlorides (as Cl)	..	..	33.00	..	70.00	..
Nitrites (as N)	..	..	0.05	..	0.10	..
Nitrates (as N)	..	..	0.30	..	0.76	..
Period of agitation—	5 mins.	6 hrs.	24 hrs.	5 mins.	24 hrs.	
Total number of bacteria in 1 c.c. of liquor after settlement	50,500	..	30,000	..	4,720	..
Percentage reduction	..	..	40.6	..	90.7	..
Number of <i>B. coli</i> (or closely- allied forms) in 1 c.c.	43,200	..	30,000	..	3,620	..
Percentage reduction	..	..	30.0	..	91.6	..
Number of <i>B. typhosus</i> in 1 c.c.	..	..	..	..	15,000	..
Percentage reduction	..	..	..	..	..	99.6

Obviously there is still incomplete nitrification but a definitely greater production of nitric nitrogen. The reduction of *B. typhosus* is the most marked feature of the bacteriological counts.

From these figures—each the average of some ten samples—one might tentatively infer, for a large plant

(i) That in a bio-aeration plant working to standards of chemical efficiency, there is a marked diminution of organisms, and particularly of coliform organisms, in the final effluent, but not any better reduction than is obtained by other recognized methods of sewage purification.

(ii) That the reduction factor of *B. typhosus* is much more marked.

(iii) That the coliform organisms are not, however, mere intruders, but probably play an active part in purification, the process being retarded in the absence of live sewage organisms.

(iv) That sterilization of the effluent may be effected by the addition of four parts per million free chlorine from bleaching powder.

Since these experimental findings have been completed, Courmont, Rochaix and Laupen (*Comptes Rendus*, 1921) have published further results which agree remarkably with the above conclusions. They now state that action normally ceases with the disappearance of ammonia, and that by this time the bacterial purification is very variable and rarely over fifty per cent. Much longer aeration would be needed to reduce *B. coli* markedly, and after the usual period of chemical purification—they found six hours sufficient—pathogens of the typho-coli group would invariably be found, though *Cholera vibrios* disappeared. They conclude that the disappearance of pathogenic coliform organisms is not affected by aeration, but depends essentially on the vital concurrence of other organisms; for while they never survive over four days in raw sewage, or over three days in a mixture of raw sewage and activated sludge, they survive much longer in sterilized

aerated sewage even after the addition of activated sludge. This is entirely in accord with our table (page 48).

Recently Richards and Sawyer have published some very interesting results (*Journ. Soc. Chem. Ind.*, March 15, 1922) dealing with the activities of the organisms in the sludge. They find that in sewage previously treated with toluene to destroy protozoa (cf. our "sterilized sewage") nitrification is delayed and minimal in amount, even although the bacterial content rises. Possibly the nitrifying bacteria were also killed, but the experiments point to the protozoa as the essential factors in the process. They group the organic content into (a) an ill-known group of ammonia-fixing organisms; (b) a group of nitrifying and denitrifying organisms, and (c) protozoa. Flagellates predominate when aeration is poor, ciliates when it is free. There appears to be a maximal content in active sludge of some million protozoa per gramme of wet sludge, and a very perfect correlation between bacteria and protozoa—the former increasing in number as the latter decline, and vice versa. They explain the action which goes on as an immediate fixation of ammonia by group (a) organisms, and a continuous nitrification by those of group (b), constantly altering the concentration so that the process is continuous, and nitrogen accumulates both in the bodies of the ammonia-fixing bacteria and as products of their activity. Simultaneously the protozoa assimilate the former organisms and so accumulate much of the nitrogen in their own bodies. In this way old ripe sludge appears to have an excess of nitrogen compared with that of the inflowing sewage—a fact which gave rise to the fixation-of-atmospheric-nitrogen theory. A point is reached (about one million protozoa per gramme of wet sludge, and with a nitrogen-content of some three per cent of the sludge in the dry state) when toxic by-products prevent further increase. Digestion of dead protozoal bodies then liberates more nitrates into the effluent than would be expected from the ammonia-content of the entering sewage. This is a valuable and clear piece of work, and goes far to explain hitherto anomalous results.

In a bio-aeration plant, sludge gradually accumulates in excess, and has to be disposed of. This activated sludge is of greater manurial value than ordinary sewage sludge, in respect of its nitrogen content, *vide* the following figures of analyses from our small plant:—

			Mineral matter Percentage		Organic and volatile matter Percentage		Total N (Kjeldahl) Percentage
Crude sewage sludge	..	..	83.6	..	16.4	..	0.66
Activated sludge	..	..	56.2	..	48.8	..	2.00

The high ash figure is explained by the quantity of sand blown into the public sewers, and in consequence the nitrogen content is proportionately low. It is evident that quite three times as much nitrogen is present in activated sludge as in ordinary sludge, a proportion found fairly constantly by workers all over the country. Ardern showed that in the activated sludge there is an actual increase of solids from flocculation of colloidal

sols and growth of higher organisms, and Richards and Sawyer have explained how this comes about (*vide supra*), showing that the protozoal bodies are responsible for quite half of the extra nitrogen in excess of ordinary sewage solids, and suggesting that the extra potash and phosphorus are due to the same common biological origin. At Harpenden they recovered over 15 per cent of the total nitrogen—a very high figure when contrasted with older installations. Reference should be made to the original quoted papers for details of fertilization tests which produced double quantities of grain where activated sludge was used, as against unfertilized crops.

These notes are in no sense final, but as bio-aeration practice is extending, we feel that any relevant data should be made public.

We wish to record our thanks to Major N. V. Lothian, M.C., R.A.M.C., lately of this School, for his helpful assistance in collating our results, particularly with reference to their bearing on recent work published since the departure of one of us (H. N. S.) for India.

INFECTION OF MAN BY AN ORGANISM CLOSELY ALLIED TO *BACILLUS SUYPESTIFER* (HOG-CHOLERA).

WITH NOTES ON A CASE.

BY LIEUTENANT-COLONEL J. MACKENZIE.

Royal Army Medical Corps.

Assistant Director of Pathology, Irish Command.

(From the Command Pathological Laboratory, Dublin).

MEDICAL literature contains very few references to *suypestifer* infections in man, and the cases on record are inconclusive in their evidence as to the specific nature of the organism found.

The following case and a description of the causative organism may therefore be of interest.

(1) CLINICAL.

Private S., aged 19, was taken ill on November 27, 1921, with headache, pains in the back and limbs, and cough.

There was no history of any previous illness, and there was no case of enteric fever in the unit. Patient had been inoculated with $\frac{\text{T.A.B.}}{2}$ in July, 1921.

On admission on November 28, the temperature was 101° F., pulse slow and regular; cough dry and frequent. There was slight pharyngitis, and the uvula was swollen and oedematous. The tongue was swollen, indented by the teeth at the edges and fissured. There was anorexia, also drowsiness and slight coryza. The temperature fell steadily, till by the evening of the 29th, it was 98.4° F. The symptoms abated and the temperature remained normal for the next three days. The case was diagnosed "acute inflammation of the naso-pharynx," in common with all influenza-like cases at that time, the beginning of the 1921-22 epidemic. The diagnosis was subsequently changed to "pyrexia of uncertain origin."

On the evening of December 2, the temperature rose sharply, and on the morning of the third was 103° F., pulse 110, respirations 20. The abdomen was slightly "full" at the upper part. Nasal discharge was excessive and there was slight bronchitis. Lumbar pain was present, also pain in the calf muscles. Temperature fell during the next forty-eight hours, and on the evening of the 4th was 98.6° F. Another steep rise carried the temperature to 102.4° F. on the morning of the 5th. During December 6, it fell to 100.4° F., and then for the third time showed a sharp rise during the night, reaching 102.5° F. on the morning of the 7th. From this point a pyrexial wave of 103° to 104° F. lasted till the morning of the 11th, when the temperature fell steadily through twenty-four hours and

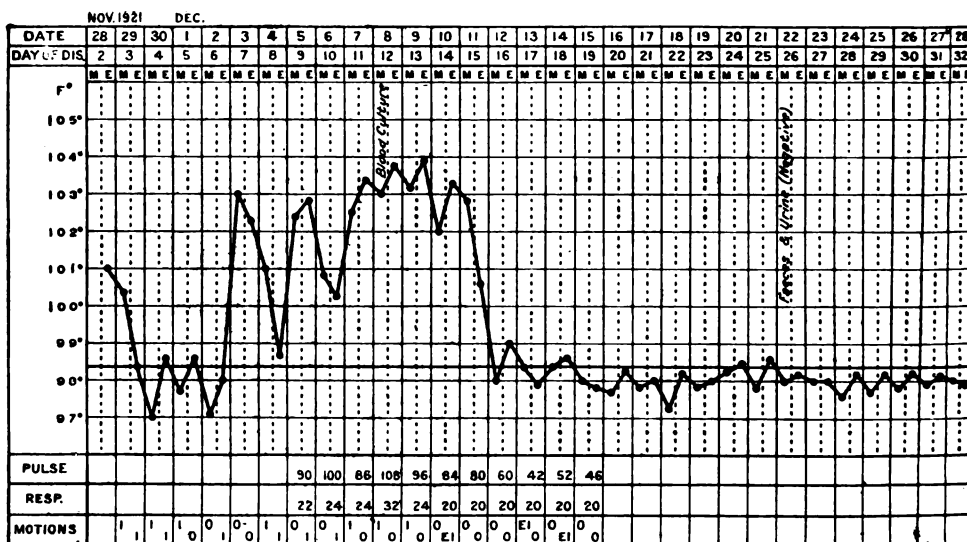
52 Infection by an Organism allied to *Bacillus suipestifer*

reached 98° F. on the morning of the 12th, remaining normal after that date. The pulse remained slow throughout the second pyrexial period, and the general symptoms were notably slight and out of proportion to the temperature.

(2) THE ORGANISM.

(a) *Morphology*.—On December 8, the temperature being 103° F., five cubic centimetres of blood were withdrawn from the median basilic vein and injected into sterile ox-bile. After twenty-four hours this was plated on MacConkey's medium and on litmus lactose agar. Both yielded alkaline colonies only, which were found to consist of motile Gram-negative bacilli having the general appearance of typhoid organisms.

(b) *Cultural Characteristics*.—The organism grows readily on all ordinary media, does not liquefy gelatin, and does not produce indol. In



litmus milk it produces acid, which gives way after forty-eight hours to alkali and the milk remains strongly alkaline. On putting the organism through the usual sugars (the first six in the table) it was noted that after twenty-four hours there were acid and gas in the glucose and maltose tubes, acid only in the mannite, while lactose, saccharose and dulcitate remained unchanged. After a further twenty-four hours gas appeared in mannite, but *dulcitate* remained unchanged on prolonged incubation. On repeating the sugar reactions acid and gas were present in mannite after twenty-four hours but *dulcitate* remained unaltered as before.

Other sugar reactions were now tested. A whole series (Table A) was inoculated with the organism, while a similar series was inoculated with

B. paratyphosus B and the two incubated together. It was found that the reactions of the organism agreed with those of *B. paratyphosus* B except in the case of three sugars, namely, dulcitol, which was not changed till the eighth day, and arabinose and inositol, which remained permanently unchanged.

As these reactions were suggestive of *B. suispestifer* (hog-cholera), two *suispestifer* strains labelled respectively "*B. suis*" and "Bacillus from hog-cholera" were obtained from the Lister Institute, and these were found to give identical sugar reactions with the bacillus isolated from Private S., except that *dulcitol* was *unchanged* on *prolonged* incubation.

Note.—To avoid confusion, the name "*B. suispestifer*" in this article means the bacillus of hog-cholera, and does not include *B. Aertrycke*.

TABLE A.

	Glucose	Lactose	Maltose	Saccharose	Mannite	Dulcitol	Inulin	Salicin	Levulose	Xylose	Raffinose	Arabinose	Inositol	Sorbitol	Galactose	Litmus milk
<i>B. paratyphosus</i> A	AG	0	AG	0	AG	AG	0	0	AG	0	0	AG	0	AG	AG	A then Alk.
" " B	AG	0	AG	0	AG	AG	0	0	AG	AG	0	AG	AG	AG	AG	A then Alk.
" " C	AG	0	AG	0	AG	AG	0	0	AG	AG	0	AG	0	AG	AG	A then Alk.
<i>B. Gaertner</i> ..	AG	0	AG	0	AG	AG	0	0	AG	AG	0	AG	0	AG	AG	A then Alk.
<i>B. Aertrycke</i> (Newport)	AG	0	AG	0	AG	AG	0	0	AG	AG	0	AG	0	AG	AG	A then Alk.
<i>B. Aertrycke</i> (Mutton)	AG	0	AG	0	AG	AG	0	0	AG	AG	0	AG	AG	AG	AG	A then Alk.
<i>B. suispestifer</i> ..	AG	0	AG	0	AG	0 ¹	0	0	AG	AG	0	0	0	AG	AG	A then Alk.
Bacillus of Pte. S.	AG	0	AG	0	AG	0 ²	0	0	AG	AG	0	0	0	AG	AG	A then Alk.

¹ Some strains produce acid and gas after varying periods of incubation. (Andrewes and Neave.)

² Acid and gas on eighth day.

(c) *Serological Characters.*—With the patient's own serum taken on the forty-fourth day from onset the organism agglutinated in dilutions up to 1-80. Had the serum been taken earlier, no doubt agglutination would have been obtained in higher dilutions.

54 *Infection by an Organism allied to Bacillus suispestifer*

With high titre sera the results were as follows:—

On first isolation							
Para A	..	..	..	..	..	..	—
Para B	..	..	..	..	..	..	1·20
Gärtner	..	..	..	..	..	..	—

After subculturing many times the organism agglutinated with paratyphoid B serum in much higher dilutions.

Para A	..	..	..	..	..	..	—
Para B	..	..	..	..	..	..	160/1600
Para C	..	..	..	..	..	..	320/2000
Aertrycke (Mutton)	..	..	..	..	..	..	80/600
Gärtner	..	..	..	..	..	..	—

Agglutinating sera for the bacillus of Pte. S. and for *B. suispestifer* respectively were now prepared by repeated intravenous inoculation of rabbits.

As paratyphoid C serum had given the highest agglutination, *B. paratyphosus* C was used to absorb the former.

The hog-cholera serum was absorbed with the bacillus of Pte. S.

The results obtained with these, both before and after absorption, are given in detail in Table B.

TABLE B.—ABSORPTION TESTS.

Serum	End-point of agglutination titre.				
	Bacillus of Pte. S.	Bacillus of hog-cholera	<i>B. paratyphosus</i> C	<i>B. paratyphosus</i> B	<i>B. Aertrycke</i> (Mutton)
(1) Bacillus of Pte. S. (original titre)	3,200	1,600	400	160	60
Absorbed with <i>B. paratyphosus</i> C	160	40	—	60	60
(2) Bacillus of hog-cholera (original titre)	1,600	6,000	600	320	80
Absorbed with bacillus of Pte. S.	40	400	80	40	—

(d) *Virulence to Animals*.—0·25 cubic centimetre of a forty-eight hour broth culture was inoculated intraperitoneally into a rabbit. On the sixth day the rabbit looked moribund and was killed; the organism was recovered in pure culture from the blood.

A second rabbit was inoculated intraperitoneally with 0·25 cubic centimetre of a twenty-four-hour broth culture, and a guinea-pig was similarly inoculated. Both died on the fifth day. The organism was recovered from the blood, spleen and liver of both animals, and had the same fermentative reactions as before.

The outstanding post-mortem feature was a “nutmeg” appearance of the rabbit's liver, the light and dark mottling being sharply defined.

Sections of the liver stained by the *panoptic* method show the following appearances microscopically. The nutmeg appearance is seen to be due to necrosis affecting the outer zones of the lobules. In each lobule, at varying distances from the intralobular vein there is a sharply defined line of demarcation. On the central side of this line the hepatic cells are well stained and appear normal; the sinusoids are somewhat distended. On the peripheral side of the line there is necrosis of the hepatic cells, both nuclei and protoplasm remaining unstained. In some cases the endothelial cells lining the sinusoids appear to be healthy and have taken the stain, thus marking in radiating lines the position of these channels among the unstained hepatic cells; in other lobuli only an occasional cell-nucleus has taken the stain.

Sections stained by Gram present similar appearances, the central zones of the lobules being stained red, and the peripheral zones a faint pink colour. Gram-negative cocco-bacilli can be seen in many of the cells.

Three rabbits were now inoculated intraperitoneally with *B. paratyphosus* C (Mesopotamian strain), *B. suispestifer* and the bacillus of Private S. respectively, each receiving 0.02 of a twenty-four-hour agar slope. A normal rabbit was kept under similar conditions as a control.

The three inoculated rabbits were in rather poor condition next day but recovered in a few hours. On the third day the Pte. S. and the *suispestifer* rabbit were off their food, resented handling, and looked very seedy, with slight diarrhoea and staring coat, the condition being most pronounced in the former. This rabbit *died* on the evening of the *fifth day* and the *suispestifer* rabbit died *seventeen hours later*. The *paratyphosus* C rabbit showed no symptoms after the second day, and *remained quite well*. (Another rabbit inoculated some time later with 0.5 cubic centimetre of a twenty-four-hour broth culture of *B. paratyphosus* C also showed no symptoms after the second day.)

For purposes of comparison the control rabbit was now killed and examined at the same time as the other two.

The post-mortem appearances of the two inoculated rabbits were as follows :—

		Private S. rabbit	<i>Suispestifer</i> rabbit
Liver	.. ..	Some enlargement: mottled, suggesting a "nutmeg" liver. Cut surface mottled	Ditto
Spleen	.. ..	Engorged, with pale spots on the surface. Small hæmorrhages	Ditto, but rather more congested
Lungs	.. ..	Small hæmorrhages on the surface, and in the substance	Ditto
Trachea and larynx..		Cut open; mucous membrane red and congested, with injected capillaries	Pale and healthy
Small gut		Congested patches: a few flakes of blood-stained lymph on the peritoneal surface	Ditto, but no blood-stained lymph on peritoneal surface

56 *Infection by an Organism allied to Bacillus suipestifer*

It will be seen that the morbid appearances were identical in the two animals except that the trachea and larynx of the suipestifer rabbit showed no congestion, and there were no bloody flakes on the peritoneum.

The most striking feature in both was the mottled appearance of the liver on opening the abdominal cavity, contrasting with the healthy appearance of the normal (control) rabbit.

Recovery of Organisms.

The bacillus of Pte. S. was recovered from peritoneum, lung, liver and kidney, the usual precautions as to searing, etc., being taken. Cultures from the trachea yielded lactose-fractors only. The spleen culture was contaminated and was discarded.

In the case of the suipestifer rabbit *B. suipestifer* was recovered from the lung, liver, spleen and kidney.

In all cases the organism was proved by passing it through the complete set of sugars, as in Table A.

It may be stated here that the patient's stools and urine were examined culturally on December 22 and 29 and January 5 with negative results.

DISCUSSION.

The literature of the Salmonella group (the paratyphoids, *B. Gärtner*, *B. Aertrycke*, *B. suipestifer*, etc.) is decidedly confusing, and very little help is to be obtained from textbooks.

The organisms agree in being motile, Gram-negative, not producing indol, and not liquefying gelatin. But the nomenclature is not standardized. In this country it has been the custom to include *B. Aertrycke* among the suipestifers, while in other countries these are kept distinct. Further, apart from serological reactions, there has been, until recently, practically no method of separating out and identifying the different members of the group.

According to TenBroeck [1] the only member of the group that fails to alter dulcitate and arabinose is the hog-cholera bacillus, i.e., *B. suipestifer*, while *B. Aertrycke* produces acid and gas in both. Andrewes and Neave [2] confirm this; they further make use of inositol in separating out the salmonellas, and bring out the fact that while both *B. paratyphosus* B and *B. Aertrycke* (Mutton) produce acid and gas in arabinose, dulcitate and inositol, a true *B. suipestifer*—apart from occasional strains which produce a late reaction in dulcitate—produces no change in these sugars; *B. paratyphosus* C and *B. Aertrycke* (Newport) ferment both dulcitate and arabinose but produce no change in inositol.

B. paratyphosus C only slowly produces alkali in litmus milk.

These tests have been followed during this investigation, and the results are included in Table A.

In its cultural and fermentative characters the organism under discussion differs from *B. paratyphosus* A in fermenting xylose and in not fermenting arabinose. It differs from *B. paratyphosus* B and *B. Aertrycke* (Mutton) in not fermenting arabinose and inosite. It differs from *B. paratyphosus* C, *B. Aertrycke* (Newport) and *B. Gärtner* in not fermenting arabinose. Further, it differs from all the six organisms just mentioned in not fermenting dulcitate until the eighth day. On first isolation it did not ferment dulcitate even on prolonged incubation. On the other hand it conforms to *B. suipestifer* in all its cultural and fermentative characters, corresponding with the occasional strains of that organism which produce a late reaction with dulcitate.

In its serological characters it has no relation to *B. paratyphosus* A or to *B. Gärtner*. At first it showed no relation to *B. paratyphosus* B; later subcultures reacted partially to paratyphoid B serum, but a serum of the organism under discussion produce little more than a trace of agglutination with *B. paratyphosus* B. It agglutinated with paratyphoid C serum in higher dilutions, but absorption of its serum with *B. paratyphosus* C does not remove all the agglutinins for the homologous organism. Its relation to the *B. suipestifer* strain used in the tests (bacillus from hog-cholera; type Hirschfeld) is close and interesting. Its serum agglutinates *B. suipestifer* almost to full titre, while suipestifer serum agglutinates the organism under discussion in dilutions twice as high as those in which it agglutinates *B. paratyphosus* C, and absorption of suipestifer serum with the organism deprives that serum of relatively twice as much of its agglutinins for its homologous organism as of its agglutinins for *B. paratyphosus* C. Its serological reactions thus place it in very close relationship to *B. suipestifer*.

Virulence to Animals.—TenBroeck [3] states that a typical hog-cholera bacillus should kill rabbits in from six to ten days, and that the paratyphosus C's isolated by Hirschfeld are not virulent for rabbits. MacAdam [4] and Mackie and Bowen [5] found the Mesopotamian strains of paratyphosus C pathogenic to rabbits, causing hæmorrhagic septicæmia and death in four to five days.

The strain of paratyphosus C (Mesopotamia) in our possession was non-pathogenic to rabbits.

The organism under discussion kills rabbits in five days and the pathological appearances are practically identical with those caused by the hog-cholera bacillus.

Occurrence of B. suipestifer Infections in Man.—Among the suipestifer-like organisms isolated from man, *B. icteroides* is virulent to rabbits, but TenBroeck (loc. cit.) points out that the exact relationship of *B. icteroides* to *B. suipestifer* has not been clearly demonstrated; his investigations tend to show that there is no authentic and conclusive record of a *B. suipestifer* infection in man.

CONCLUSION.

The organism isolated by blood culture in this case conforms to the strains of *B. suipestifer* in our possession in its morphology, cultural characteristics, serological reactions and virulence to animals.

A search through the literature available has failed to discover a case in which a bacillus of like reactions has been isolated from the blood of man.

I wish to express my thanks to Lieutenant-Colonel H. M. J. Perry, O.B.E., R.A.M.C., Professor of Pathology, Royal Army Medical College for confirming the failure of the organism to ferment dulcitol which led to the investigation above described.

My thanks are also due to Lieutenant-Colonel C. J. O'Gorman, D.S.O., R.A.M.C., Officer-in-Charge King George V Hospital, Dublin, and Dr. W. L. Young, in charge of the case, for permission to make use of the clinical notes.

I also wish to express my indebtedness to my senior laboratory attendant, Corporal A. W. J. Gilmour, R.A.M.C., and my other laboratory attendants for their enthusiastic assistance in carrying out the work.

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Clinical and other Notes.

NOTES ON THREE CASES OF DYSPIUITARISM: HYPOPHYSEAL INFANTILISM.

BY CAPTAIN AND BREVET-MAJOR W. L. WEBSTER.

Royal Army Medical Corps.

THE following three cases of the Lorain type of infantilism are presented chiefly because the variety of the pathological process giving rise to the condition in them may shed some light on the pathogenesis of this somewhat rare condition.

Cases of Lorain type of pituitary infantilism are met with much less frequently than those exhibiting Frolich's syndrome. These three cases all exhibit certain symptoms in common, they are all infantile, but perfectly proportioned; they look like normal children at about 10 years of age; the bones are short and thin and their epiphyses are not united; a degree of mental enfeeblement is present, and all suffer from fits periodically; one case has complete double optic atrophy; one suffers from a severe degree of mental impairment; one is mentally bright but only with the mentality of his apparent age. He is able to work for an indulgent employer and to support his mother.

The cases will be described under the headings "E. C.," "M. K.," and "W. B."

Case of "E. C.," aged 22.

Family History.—Good.

History.—Until 7 years old he appeared to be normal. At this time he commenced to have fits, which have continued since, occurring once or twice a week. He has an aura which consists of a sensation of terror; he is convulsed for about ten minutes and is dazed afterwards. At 10 years old he lost his vision; he was at this time unconscious for seven days and became blind in his right eye and the left eye gradually became blind in the next six months. Attacks of vomiting and headaches have been present for the same time as the fits. In appearance he looks about 10 years old. Height: Three feet seven inches. Hands: Narrow and tapering. Genitals: Infantile, penis very small; testes soft and small. Secondary sex characteristics, absent. No hair on face, axillæ or pubis. His muscular system is proportionate to his general development. Pulse is slow—70. Blood pressure normal. Teeth are closely set, the upper are decayed and there is a considerable amount of pyorrhœa. Pupils are equal, inactive to light, he has a divergent squint, moves eyes well in all directions; there is a slight double ptosis and nystagmus is present in all directions. He cannot distinguish light from darkness. Optic discs are dead white with slight lines along vessels (secondary atrophy). Sensation is unimpaired throughout the body. The motor system is normal, the power in muscles being fair and equal to that of a child of 8 to 10 years of age. Reflexes brisk. Plantar flexor, normal. The bones of the body are small except the pelvis which is rather larger than one would expect in a child of 10. Wassermann of blood, negative.

X-ray Report.—Lateral stereoscopic view to show sella turcica, clinoid processes mostly absorbed. Sella turcica is shallow and enlarged in the antero-posterior direction. No evidence of lateral expansion. There are definite irregular opaque shadows in the frontal region extending upwards in line with the fronto-parietal suture and in the sella itself, suggesting an extensive growth, probably an exostosis of the bone or a very slow growing tumour in which there is much calcareous deposit.

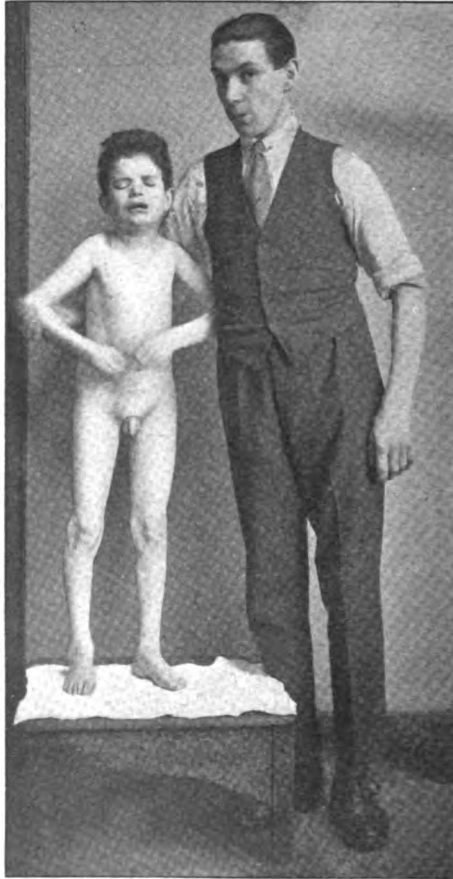


FIG. 1.—Case of E. C. The two individuals are the same age (22 years).

Case of "M. K.," aged 19.

Family History.—Good.

History.—Patient started working at 14 years of age. He has **always** been very small for his age and his voice has always been high-pitched and childish. Five weeks ago he was knocked backwards on to his head and was **unconscious** for a few minutes. There was no bleeding from nose or head or ears, and no vomiting. He had a headache for two days which then passed off. **Two** weeks after the accident his mother noticed he was groping for his bread and **butter**, and

she realized he could not see well. His mother states that he has never shown any interest in the opposite sex, so much so that his friends make a joke of it.

On admission he could not read small print, but only the headlines of newspapers. He could walk well. He had no pains, paræsthesia, or numbness. He looked about 12 years old, was perfectly proportioned and his skin was soft and rather waxy looking. All bodily contours were childish. Height: three feet six inches. Hands narrow and tapering. Genitals: Infantile. Patient shows no embarrassment in being examined. Secondary sexual characteristics: There is no hair on face, axillæ or pubis. Muscular system: this is proportionate to his general development. Pulse, 88. Blood-pressure normal. Teeth are bad, but are not

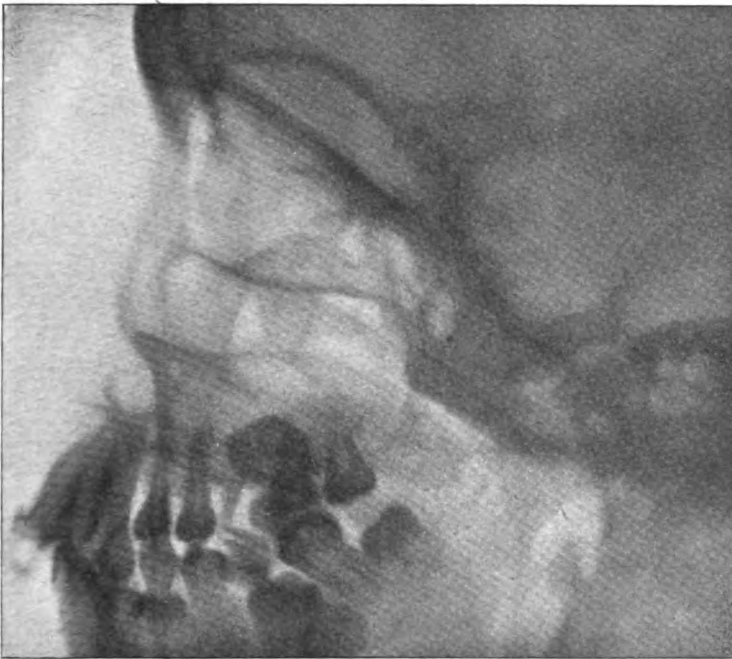


FIG. 2.—Case of E. C. Lateral stereoscopic view to show sella turcica. (For report, see notes of case.)

notched nor peg-like; bridge of nose is well-formed; the lower jaw is rather overhung. There are puckered linear radiating scars round the mouth, more marked in central parts than at the corners. Skull is small and round, maximum circumference, $20\frac{3}{4}$ inches. Cerebration is quick, he is bright, intelligent and emotionally normal except for his sexual emotions. Pupils are equal, react to light and accommodation, on looking to left and upwards a few nystagmoid movements are seen, which disappear after a few seconds' fixation. No other ocular palsies. Vision: visual acuity, R. 3/60; L. 1/60. Fundus, right eye, disc very white with a bluish tinge; vessels not thickened. Left eye, disc as right; retina in outer equatorial region atrophic. Other cranial nerves normal except that tongue when protruded goes slightly to the left. Sensory system normal, except that

there is a slight loss of sense of position in the upper limbs, chiefly the left, as shown in the nose-finger test and in the left lower limb as shown by the knee-heel test. Motor system, left grip is weaker than right. There is some ataxia in left leg, slighter in right leg. Reflexes normal and brisk; plantars flexor.

Examination of cerebro-spinal fluid, clear, colourless. Two small mononuclear cells per cubic millimetre. Albumen, 0.025 per cent. Nonne Apelt reaction, weak positive. Lange's goldsol test, 4332321000. Wassermann reaction strongly positive in both blood and cerebro-spinal fluid.

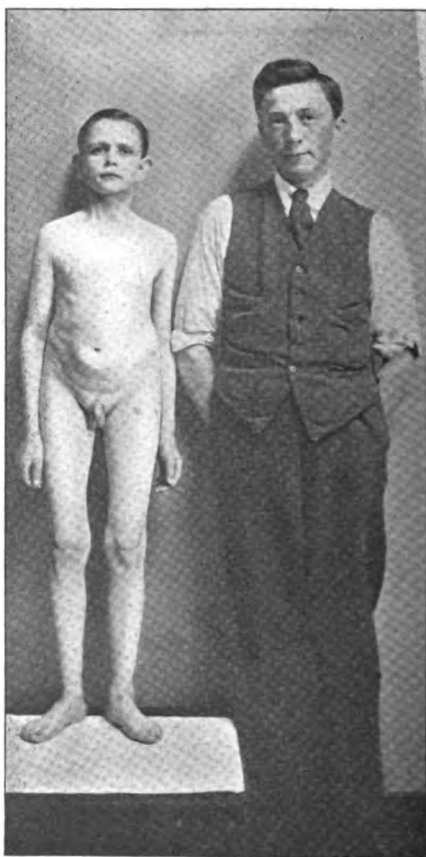


FIG. 3.—Case of W. B. The two individuals are the same age (25 years).

X-ray, sella turcica normal.

Under treatment with mercurial inunction and novarsenobillon he improved considerably. His infantile condition remained the same.

Case of "W. B.," aged 25.

Family History.—Nothing of interest.

History.—His mother says he had meningitis when 5 years old, and that he did not grow after this age. After this illness he had occasional fits for a year;

they then ceased for four years; for the past fifteen years he has had approximately one fit per month. These fits appear to be true epilepsy, and sometimes occur as petit mal when he loses himself for two to three minutes, without convulsions.

He has been at work for some years with a firm who allow him to be absent when he does not feel well. In appearance he looks about 10 or 12 years old, Height: Three feet ten inches. Hands are tapering; genitals infantile; penis small

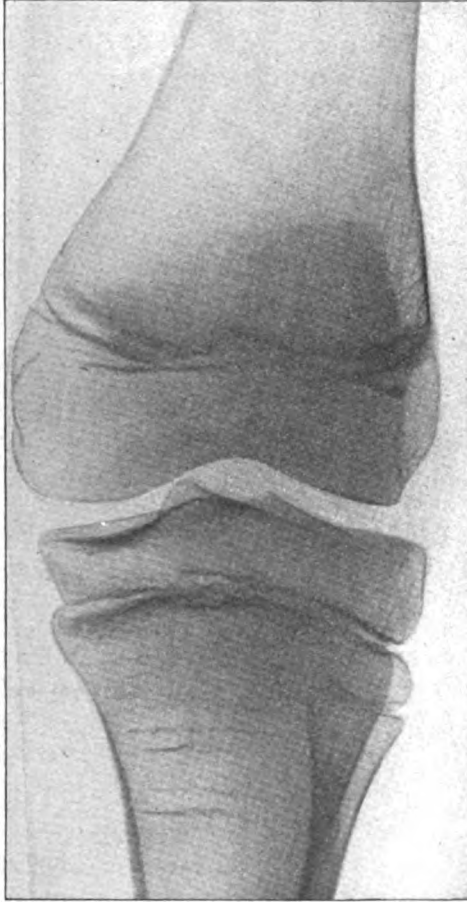


FIG. 4.—Case of W. B. X-ray of knee showing ununited epiphysis.

and testes soft. Secondary sexual characteristics: He has no hair on face, axillæ or genitals. He never felt any attraction towards the opposite sex until about twelve months ago; during the last twelve months he has had feelings of slight attraction and has felt sexual desires. Pulse, 80; blood-pressure, normal; teeth are good and well spaced.

On examination there is nothing to note in any of the systems. No affection of the cranial nerves, fundi normal; motor and sensory functions are unimpaired. Cerebration: He is bright, quick and intelligent, and is emotionally normal.

A suggestion of adiposity is noticed in this case. This is more obvious in the photograph than on inspecting the patient.

Note.—Treatment by ant. lobe of the pituitary in all cases made no improvement in their condition.

I wish to express my thanks to Dr. Gordon Holmes for permission to publish these cases, and to Dr. J. G. Greenfield for taking the excellent photographs and for his helpful interest.

REPORT ON A SERIES OF CASES OF AN UNUSUAL ERUPTIVE FEVER.

By MAJOR J. E. H. GATT.

Royal Army Medical Corps.

(1) *Clinical Features, Seasonal Incidence, Distribution, etc.*—Between the middle of August and the end of September, ten or eleven cases of this nature came under our observation at the Curragh; showing, individually or collectively, the following signs and symptoms:—

(a) Incubation period, as yet uncertain.

(b) Sudden onset, with frontal headache, conjunctival injection, more or less sore throat, with or without coryza. In one or two cases epistaxis; very moderate fever, with vague joint pains.

Within a few hours a rash appears, generally on the trunk, deltoid region, and proximal segments of the limbs. In a few cases the forehead and face are involved in a dull red flush, which is almost always more uniform. In the latest cases observed, the rash was obviously most developed in the hairy parts, the neck, the armpits, the front of the chest, and all parts most subject to pressure.

The coarse appearance of the rash certainly suggested rubella; but on passing the finger one could not help being struck with its absence of depth, except in very few places. A magnifying lens showed that by far the most extensive lesion was an erythema, chiefly affecting the pores of sweat glands, and the base of hairs. A few stray papules also were discernible here and there, with in most cases one or two petechiæ. The general colour of the rash was dull red.

All cases showed natural diaphoresis, and in some there was also skin irritation. On the whole the illness lasted three to four days. Up to date no trace of desquamation was observed, even in the most extensive rash. The last case was somewhat unusual in that the temperature was only 99° F. on the first day and remained normal afterwards; further, whereas in all previous cases the rash disappeared almost completely after forty-eight hours, in this case it was persistent on the third day, and became semipurpuric (not disappearing on pressure).

It is well to remark here that this patient had been under treatment for a chronic arthritis for a week and three applications of dilute picric acid dressings had followed a blister; it was even suggested that the peculiar rash was a drug rash. The urine however was normal, except for an excess of urates.

There were no complications, but one case from another source, which had no connexion whatever with the above, developed higher fever, with several

glandular enlargements and a leucocytosis with seventy-three percentage mononuclears. This observation will be referred to later.

There were no Koplik's spots nor otherwise any glands to be felt.

Bacteriological Findings.—Throat swabs, collected as early as possible yielded mostly Pfeiffer's bacilli, with some associates, most commonly diphtheroids, Gram-positive diplococci, or *M. catarrhalis*.

(1) Agglutination tests were made against Pfeiffer's bacillus isolated from some of the cases, and positive results up to 1 in 100 in three cases were obtained.

(2) There was no appreciable change in the blood elements (with the exception of the case already referred to) but if any, it was in the sense of a moderate leucocytosis.

I have attached to this report¹ some references, but prefer for the present to abstain from discussion. Cases of this nature have certainly come to notice before, and even in the spring of this year, something very similar was reported by the Medical Correspondent of the *Times*.

SOME CLINICAL DETAILS FROM A DEPOT HOSPITAL.

BY BREVET MAJOR C. S. P. HAMILTON, D.S.O.

Royal Army Medical Corps.

(1) A CARDIAC AND ANEURYSM CASE.

PATIENT, Serjt. G., aged 29. Nine years' service. Admitted on August 23, 1921, with the following history:—

History.—Up to eight weeks ago he was absolutely fit, doing ordinary duty as permanent instructor to an Infantry Territorial Unit. His duties included physical training instruction to his men, and he himself actually performed the various physical training movements up to the day of his illness. He was a physical training instructor in France for the last three years of the war.

Eight weeks ago, on or about June 23, 1921, the patient was taken ill with severe pains across the lower part of the chest and the pit of the stomach, the pain completely "doubled him up." He went to a doctor who diagnosed his case as "gastritis," and sent him away for a fortnight's leave. When he returned from leave he noticed himself getting short of breath, and the pain, though better, still came on at intervals, no vomiting. Bowels were not constipated. He went to another doctor about a fortnight after returning to his work, as he found himself unable to do his duty. The doctor now found that he had a "lump" behind his right knee. He was ordered to bed, but actually only rested during the day in a chair, and walked about the room as he wished. His doctor wrote to his Unit, and applied to have him removed to hospital, suffering from "popliteal aneurysm and cardiac disease."

Previous Illnesses.—He was never sick during the whole of his service, and never remembered any illness since childhood; did not give any definite history with regard to infectious fevers. Married; no children; wife no history of miscarriages.

¹ Printed elsewhere as Current Literature.

Condition on Admission.—Admitted on August '23, 1921, the journey in the ambulance was a long one, being about twenty-five miles. On admission his condition was as follows: Face white and puffy; lips cyanosed. Expression anxious, marked dyspnoea. Marked clubbing of the fingers. A large pulsatile swelling in the right "popliteal space" which proved to be an "aneurysm." Pulse 124; temperature, 99.4°F. On examination of the chest, bulging over præcordial area, marked heaving. Pulsation over the whole of the apical area; right side of heart $\frac{1}{2}$ inch to right of sternum. Apex beat downwards and outwards sixth space $4\frac{1}{2}$ inches. On auscultation a double mitral murmur conducted both outwards and upwards, very loud. These murmurs were heard over all the valvular areas, and entirely obliterated any normal heart sounds. The lungs showed some râles over both the bases posteriorly. The left carotid, the left axillary, brachial and radial pulses were almost entirely obliterated; a feeble pulse was, at times, just perceptible, but so feeble that one could hardly appreciate it, whilst the right pulse was well marked, though irregular in force and rhythm. Blood-pressure, 129-125, right radial. Left side no blood-pressure record could be taken. Eyes: Reacted to light and accommodation. Mouth: Septic stumps and gingivitis; tongue, dry furred. Liver: Palpable and tender. Spleen: Palpable and tender; some ascites. Urine: Specific gravity, 1020; albumen ++ present; bile salts present. Blood: Negative to Wassermann reaction on two occasions.

On the second day in hospital the patient had a temporary left-sided facial paresis from which he recovered in eighteen hours.

Treatment.—Patient was treated with pot. iod. and a modified "Tufnell diet." His condition was desperate from the very beginning, and he died on September 7, 1921, i.e., fifteen days from the date of admission, and two and a half months from the onset of the disease. No post-mortem was obtained.

SUMMARY.

As seen from the above history, the case is remarkable because:—

- (1) Of its sudden onset without any definite history of previous illness.
- (2) Its rapid course.
- (3) The considerable arterial degeneration.
- (4) In the absence of a positive Wassermann reaction and any objective signs of syphilis, it is difficult to assign a cause for this serious and rapid cardiac condition. Oral sepsis plus the strain of physical training may have been contributing causes.

(2) NOTES ON TRAUMATIC SYNOVITIS OF THE KNEE JOINT.

Traumatic synovitis of the knee joint is, without doubt, serious when occurring in a young man whose livelihood depends upon his agility.

The tendency is to relegate this injury to the class of minor troubles, to record that "it will not interfere with the future efficiency of the soldier," and on the part of the medical profession generally to treat it with scant attention. How often one hears a patient, when giving a history of his affection, say, "I was treated by a doctor just for a few days; he painted the knee with iodine, and told me to wear a bandage."

Below is appended a table, showing a few cases admitted to the Crowborough Military Hospital, from July 10, 1921, to October 30, 1921.

No. of case	Joint injured	Mode of injury	Total service on admission	Total number of injuries	Length of time under treatment each injury						Total time in hospital	Percentage of total service in hospital	Remarks
					1st	2nd	3rd	4th	5th	6th	7th		
1	S.R.K.	Whilst riding ..	32 weeks	Two	3	5					8	21.6	First three injuries in civil life
2	S.L.K.	Football ..	60 "	Three	20	8					34	51.5	
3	S.R.K.	Fell on rough ground	28 "	Five			6	8	3		11	35.8	
4	S.L.K.	Twist, running	104 "	One	4						4	3.69	* Transferred to another hospital
5	S.R.K.	Football ..	104 "	Five	5	3		5	2*		17	16.03	
6	S.R.K.	Boxing ..	26 "	Two	4	1					5	18.5	
7	S.R.K.	Walking ..	28 "	One	3						3	9.6	
8	S.R.K.	Football ..	338 "	Three	5	4	3				12	3.5	
9	S.R.K.	Football ..	20 "	Two	Not treated	5					5	20.0	
10	S.L.K.	Football ..	88 "	Two	5	4					9	9.7	Transferred to another hospital
11	S.R.K.	Kicked by horse	130 "	One	5						5	3.69	
12	S.L.K.	Football ..	208 "	Two	4	4					10	4.6	
13	S.R.K.	Hockey	78 "	Two		3					3	3.7	† Transfer
14	S.R.K.	Skating ..	8 "	One	4†						4	33.3	
15	S.R.K.	Football ..	80 "	One	8						8	9.09	Two first injuries in civil life
16	S.L.K.	Hit with stick	308 "	One	2						2	0.64	
17	S.R.K.	Football ..	6 "	Three	Civil life		7				7	53.8	
18	S.L.K.	Kicked by horse	32 "	One	4						4	11.1	Transferred direct to another hospital
19	S.L.K.	Football ..	308 "	Seven	Six first injuries in civil life and seventh displaced cartilage								
20	S.R.K.	Kicked by horse	36 "	One	Transferred								Transferred direct to another hospital
21	S.L.K.	Knock on bench	40 "	Three	Civil life		4				4	9.09	
22	S.R.K.	Kicked by horse	24 "	One	2						2	7.5	Two first injuries in civil life
23	S.L.K.	Football ..	78 "	Two	20	2					22	27.5	

S.R.K. = Synovitis right knee. S.L.K. = Synovitis left knee.
All figures are in weeks. Percentage derived from the total service up to the day of discharge from hospital.

On analysing this table the following deductions can be arrived at:—

The total number of cases admitted for traumatic synovitis of the knee was twenty-three. In fourteen of these cases the right knee was affected; in eight of these cases the left knee was affected; in one of these cases both knees were affected.

Direct force caused the injury in six cases. Indirect force (twists, etc.), was the causative factor in nineteen cases.

From the table it will be seen that a definite history of injury to the knee in civil life was obtained in three cases, but probably this falls far short in number of the exact figure. The actual percentage of time spent in hospital out of the patients' total service is interesting, but does not of itself prove anything very much, as so many of the actual patients are recruits with very short service. However, a few cases should certainly be mentioned, such as:—

Case No. 2, total service sixty weeks, percentage of time in hospital, 51.5 of total service.

Case No. 3, total service twenty-eight weeks, percentage of time in hospital, 35.8 of total service.

Case No. 5, total service 104 weeks, percentage of time in hospital, 16.03 of total service.

Case No. 23, total service seventy-eight weeks, percentage of time in hospital, 27.5 of total service.

Careful measurements of the calf and thigh muscles were taken in every case. (The calf muscles were measured at an equal distance in each leg above the tip of the internal malleolus. The thigh muscles were measured at a point four inches above the adductor tubercle in each thigh, thus obviating any possible mistake, such as including the upper part of the synovial sac of the knee-joint).

The Result of the Measurements in the Various Cases.—Marked wasting in the quadriceps extensor group of muscles on the affected limb was found in eight of the cases out of twelve. These twelve cases were all those in which one or more previous injuries had occurred. In five cases admitted for first injury, some slight wasting of the quadriceps extensor was found, and in each one of these five cases the wasting was of the muscles of the affected limb. In no case was wasting found in the sound limb.

The calf muscles only showed wasting in four cases, in two of which the wasting was marked, and they both had histories of several previous injuries, and in the other two cases the wasting, though being noticed in the affected limb, was only slight, and these were primary cases.

Marked flat feet in the early stage was noticed in four cases, and the condition was always more marked on the affected side. In three of these cases there was a history of more than two previous injuries; the remaining one being a primary case.

The Final Aim in Treatment is Threefold:—

(1) To rid the joint of fluid and, if possible, the synovial membrane of all thickening.

(2) To reproduce full range of movements in the joint.

(3) To improve the tone of the muscles of the thigh and leg, thereby also improving the tone of the capsule and ligaments of the knee-joint.

The final ambition should be to procure measurements of the thigh and calf

muscles of the affected side equal to the normal measurements of the muscles of the unaffected side, i.e., the measurements taken on admission. Unless the muscles and ligaments do obtain as near as possible their normal tone, the likelihood of future injury is very great. It must be borne in mind that a stretched capsule and ligaments generally remain weak for a considerable time, and on this assumption regulation of a patient's future work greatly depends. An infantry-man certainly should not be allowed to resume full duty too soon. Treatment prolonged a few weeks will probably save many months of enforced future illness.

One can meditate on this table and ask oneself the following questions :—

- (1) Is traumatic synovitis of the knee a trivial disease?
- (2) Should recruits with a history of injury to the knee be enlisted if any signs are observed?
- (3) Should a knee-joint once injured, however slightly, providing that fluid is present, be treated at an M.I. room or in quarters?
- (4) What guide is there as to how one should fill in the Accidental Injury Form B. 117?
- (5) What action should be taken with regard to a patient's future service?

To the above questions the following answers seem most fitting :—

- (1) Traumatic synovitis of the knee-joint should never be looked upon as a trivial disease.
- (2) Any man presenting himself for enlistment should be rejected if a history of previous injury to the knee within the last twelve months is obtained, and at the same time thickening of the synovial membrane is found. Also he should be rejected even if no history is obtained when any marked thickening of the synovial membrane is observed in a knee-joint.
- (3) No synovitis of the knee-joint should be treated, except under conditions when the patient is able to lie in bed until all the fluid has disappeared.
- (4) Army Form B. 117, when filled in, cannot be truthfully completed "unlikely to affect his future efficiency as a soldier." Any traumatic synovitis is liable to affect a soldier's future efficiency.
- (5) If a patient has suffered from more than two attacks within twelve months from his injury, then he should be sent up before a Board with regard to his fitness for further service.

Naturally the man's work must be taken into account; a cavalry-man or infantry-man is more liable to break down completely through an injured knee, than a headquarters clerk or nursing orderly.

Probably many will disagree with the above views, but this article will serve its purpose if it calls attention to the fact that knee cases require serious thought.

Permission to publish the above notes has kindly been given me by Lieutenant-Colonel J. G. Bell, D.S.O., the Officer Commanding Crowborough Military Hospital.

Travel.

TRAVELLING IN MESOPOTAMIA.

By MAJOR J. E. M. BOYD.

Royal Army Medical Corps.

A FEW days ago, after many wanderings, extending over six weeks, I reached Basra from England, and duly reported my arrival, next morning, to the Assistant Director of Medical Services, Basra area. I was told to go to the combined base depot and await instructions. On the following morning I went to see the officer commanding the base depot, with a view to getting some warm clothing for my bearer; he said there was a troop train going that evening to Baghdad, and that as a medical officer was needed I had better go by it in case of accidents. He said that he would make all arrangements as regards orders and medical equipment.

The draft consisted of 17 officers and about 250 men of the Royal Air Force, with 50 other ranks of the Norfolk Regiment. During the early part of the afternoon the drafts moved off to entrain, but as I had heard nothing from the Assistant Director of Medical Services, I was still uncertain whether I was to go or not.

About 4.30 p.m., I again saw the officer commanding the base depot and asked him if he had heard anything about my going; he said everything was all right and that the train left Mekina Station at 10.22 p.m.

I asked for transport for my heavy luggage, and an army transport cart was at once placed at my disposal. In the meantime the Royal Air Force officer in charge of the entraining turned up and said all kits had been loaded and the vans sealed and that the train was then at a siding about two and a half miles away, but was moving at 5 p.m. to the station at Mekina, to which place he advised me to send the kit. The army transport cart left with my bearer sitting in a most precarious position on top, my topee in one hand and a hurricane lantern in the other. I thought it might be advisable to go up to the station, a mile and a half away, but was told that it was no use my going up then, as the train could not possibly have arrived, so at about 6.30 p.m. Major Fraser, D.S.O., R.A.M.C., who was on his way to Egypt, walked over with me. We found that the army transport cart and my bearer had safely arrived, but there was no sign of the train. We found the station-master, a Madras, who was most obliging and did all he could; he said I was to travel in a first-class compartment, with a wing commander, Royal Air Force, and the officer commanding train; he expected the train about 8 p.m., and advised me to be at the station again about 9 p.m., and that he would then fix up everything for me, so Fraser and I returned to the combined base depot for dinner.

About 8.30 p.m., I again left for the station and as it was a cold night with a full moon, decided to walk, not caring to entrust myself to a Ford taxicar driven by a half wild Arab. I had seen these cars by daylight and expected to see them fly into fragments at any moment.

By this time the train was at the station and had been attached to the ordinary up train. The accommodation consisted of a twenty-berthed ambulance coach for the seventeen officers, quite a comfortable conveyance, divided into five compartments, each with four berths, and ten covered goods vans for the Royal Air Force personnel; as some of these vans contained twenty-six men with rations and blankets, it was considered that they were overcrowded, so three more vans were asked for "on medical grounds" and were at once provided. The Royal Air Force warrant officers had comfortable second-class sleeping carriages and the two Royal Air Force officers and myself an ordinary first-class sleeping carriage on the up train to ourselves. A large tank of chlorinated water was also attached together with a dry canteen, which later proved a godsend.

We had been warned to prepare for disaster and to take food with us; as will be seen later this warning proved only too true.

The train, when finally completed, consisted of forty-five coaches in all, but as we were told the country was quite flat, we were all quite cheerful.

There was a little grumbling on the part of some of the men of the Royal Air Force owing to the fact that the Norfolk draft had third class carriages, the former having goods vans. Personally, I considered that the Royal Air Force were better off, as they could lie down at night, whereas the Norfolk's had to sit up all the time.

The station-master had by this seen to the loading of my baggage and had found a seat for my bearer in the train; he then came to me for advice as regards his health. He complained that he had been in Mesopotamia since 1916, and was becoming very fat. I gave him what consolation I could but was interrupted by the arrival of a Royal Army Medical Corps orderly, accompanied by a ward servant, with the medical equipment. This was packed in an old Rose's lime juice cordial box, and was well thought out, only what was likely to prove of use being sent, such as quinine, aspirin and castor oil, with dressings in case of burns or injuries, all useless articles being eliminated. This box was added to the rest of my "cabin" luggage, and punctually at 10.22 p.m. the train started. Just outside the station an Arab "jumped" the train and apparently got a free ride to his destination. There being nothing else to do we went to bed. Breakfast was to be served at about 7.30 a.m. at Ur junction. I awoke several times during the night and on each occasion the train appeared to be at a standstill and I thought that there must be a great number of stations on the line. We turned out next morning at about 8, and as the train had stopped, asked if we had halted for breakfast. The station at which we were then standing certainly boasted of two lines of track, four lamps and a few huts; of platform there was no

sign. The guard said that we had not yet reached Ur, having only completed twenty-nine miles in about ten hours. He also said that the train had not stopped during the night, that the engine had not broken down but had only "failed," and that our breakfasting place was still about 100 miles away. At 10.30 a.m. a goods train caught us up and the engine of this was transferred to our train and we again started off. By this time we had taken just twelve hours to cover the twenty-nine miles from Mekina.

The men were perfectly happy ; at every halt they swarmed out of the train and had a run round to get warm ; at one station two Arab ponies and a donkey were captured, which some of the braver spirits mounted with great glee. As the day got warmer the men climbed all over the train, on to the cow-catcher of the engine and roofs of the carriages, whilst some, more enterprising than the rest, insisted on driving the engine. At times they were so active that I fully expected to be called upon to render first aid, but beyond a crushed finger, due to one of the iron doors falling on it, there were no casualties.

At 1.30 p.m. Jalibah was reached ; here we found that the dining car of an ambulance train had been sent down from Ur junction to meet us and we had a very good, well-cooked meal. Up to this we had lived on biscuits, dates and chocolate. At 4.20 p.m. our suggested breakfasting place, Ur junction, was reached. We found two dining tents, and hearing we were only to stop for half an hour, hurriedly ordered tea. Three and a half hours later we left. Luckily the dining car was still attached, and before leaving Ur we got in and at about 8.30 p.m. had dinner, returning to our own carriages at the next stop.

It was very cold during the night, so we did not turn out till about 9 a.m. next morning. When we asked what news there was of breakfast, the guard said we had passed the last dining place, where we should originally have had dinner, at 4.30 a.m., and that we would get no more food until Baghdad was reached ; so we again breakfasted on biscuits, dates and chocolate. Baghdad was reached about 1 p.m. I proceeded to the Maude Hotel, had lunch and reported at General Headquarters later, but as it was Saturday afternoon and the final for the Baghdad football cup was being played between the Royal Air Force and the Norfolk Regiment, I could find only an orderly.

As regards the country passed through, it has already been well described by Mr. Thomas Atkins, as consisting "of two rivers with miles and miles of damn all between" ; it was mostly flat desert, with a little scrub in places ; near Hilla were what appeared to be the remains of an old irrigation system. At places in the distance could be seen dense columns of black smoke, which seemed to indicate the presence of oil.

Along the line were old sand-bag block houses unroofed, but each containing one or more water tanks, and at each station an Arab sentry, who seemed very proud in the possession of an old but serviceable Lee-Enfield rifle.

Amongst the third class passengers were some Arab levies, who looked exceedingly smart in their khaki uniforms with shoulder chains.

Thus ended a journey which, had it not been for the general cheerfulness of the passengers, might have proved unpleasant, but as it was, was interesting and amusing.

Lecture.

THE PREVENTION OF TUBERCULOSIS.¹

BY COLONEL S. L. CUMMINS, C.B., C.M.G.

David Davies Professor of Tuberculosis, Welsh National School of Medicine, Cardiff.

AMONGST the lay public there seems to be a generally accepted belief that the "stamping out" of tuberculosis should be a fairly simple thing if only there were a big enough organization to apply the knowledge that the doctors claim to possess, and if only people were told what to do and did it. The opinion of the "Man in the Street" was crystallized into one sharp, clear question by that very able layman, the late King Edward VII, who asked, "If preventable, why not prevented?"

Doctors are to blame in this matter. Some of them, even to-day, persist in attempting to give the impression that the problem is quite a simple one, and that all that is needed is some general ideal such as "fresh air," "clean milk," "better housing," or "scientific food." All these specifics are of great value, but not one of them can be accepted as in itself sufficient to prevent tuberculosis. Cases occur amongst people leading a life chiefly spent in the fresh air; we meet with severe tuberculosis in countries where the bovine tubercle bacillus is unknown, and where, therefore, milk cannot be to blame; there are plenty of victims every day in beautiful houses amongst people well able to afford the most expensive food. As for sunlight, we see cases arise and progress with terrible rapidity to a fatal termination in countries where there is so much sunlight that men have to wear Wolseley helmets and spine pads to protect themselves from it, and where sunstroke is one of the common causes of death. Not that I wish to suggest that fresh air, clean milk, good houses, good food and plenty of sunshine are without effect. On the contrary, they are all of high value as means towards the betterment of health; and they are of especial value in tuberculosis. It is safe to say that a clean milk and butter supply for everybody would get rid of bovine tuberculosis in man, and thus save thousands of children from years of suffering and perhaps life-long deformity, while the effect of the sun's rays, skilfully used, are most powerful in treatment. But my point is that none of these things are capable in themselves of stamping out tuberculosis. We may safely advocate them all as measures that will repay our best efforts, but there is no ground for the belief that by such means alone we can get rid of the disease.

¹ A Public Lecture given at University College, Swansea.

My text to-day is "Why not prevented?" and I wish to show how it is that our efforts, so seriously undertaken and so generously endowed, have so far failed to banish tuberculosis from our midst.

The truth is that the prevention of tuberculosis is not one problem but several. Measures that will serve us against human tubercle bacilli may be useless against bovine infection; our attempts to prevent the spread of germs do not absolve us from efforts to save already infected persons from the bad conditions of life that may convert a relatively harmless bacterial focus into a progressive and fatal illness.

Let us consider for a moment some of the diseases that can be rightly called "preventable."

Malta fever is one. This is an instance of a malady which continued to defy *general* measures of hygiene until close scientific investigation provided us with a *special* measure that served at once to control the incidence of the disease.

Typhoid fever is another. Here the conquest was in three steps. When the germ was discovered, we bettered our water supplies, believing that the disease was exclusively water-borne. Thus we stamped out a certain proportion of the total incidence. Then "typhoid carriers" were discovered and attention to good latrine systems became a rational measure which, properly applied, led to the vast reduction of typhoid which England witnessed at the commencement of the present century. But there remained countries where our troops had to serve and where the conditions were such that good latrine accommodation could never be absolutely ensured. Something more was necessary. That additional something was found in typhoid vaccine which served to stamp out the disease so far as concerns our troops and which contributed so powerfully to our victory in the late war.

Here we have an example that may serve to illuminate the problem of tuberculosis. At an intermediate stage in the progress of our knowledge of typhoid fever, while medical experts, basing their faith on part of the truth, proclaimed the disease preventable, the question might well have been asked "If preventable, why not prevented?"

What we have got to realize is that the same parasitic germ acting on the same animal or human host, may behave in different ways, enter by different routes, require different measures for its prevention.

Take the case of plague. Our great epidemics are connected with epizootics amongst rats and other rodents. The germ is brought to us from the infected rats by means of fleas. The result is bubonic plague, a disease primarily of the lymphatic glands and, secondarily, of the blood-stream and the rest of the body. Measures founded on this knowledge are calculated to succeed in preventing bubonic plague. But these measures are useless in preventing pneumonic plague, a disease caused by the same germ but primarily affecting the lungs and spread by cough-spray to persons in close contact with cases. To prevent this form of the same disease we have to adopt quite different methods, chief amongst which are isolation of patients and disinfection of houses, clothing, etc.

Here too, general measures of hygiene, while to be advocated, were unavailing to stamp out the disease until close scientific research had placed the special weapons that we required in our hands. And let us remember that, armed with the knowledge that bubonic plague could be prevented by the elimination of

danger from infected rats and their fleas, we were still powerless to prevent the pneumonic form until we learnt the lesson that here rats played no part and fleas were not concerned ; but that the infected man was *the* source of peril to his neighbour.

How do these considerations bear upon tuberculosis? To begin with infection: let us remember that human and bovine bacilli reach the human body from different sources and by different routes. The former we draw into our lungs with our breath in the dust and particulate matter that is suspended in the circumambient air; the latter we swallow into our intestines in infected milk. Both varieties are apt to lodge in the neighbourhood of the tonsils as they pass through the mouth and pharynx on their way to the respiratory or alimentary passages. Now it is clear that our methods of prevention must differ considerably for these two types of germ. This is nothing new. It is a truism that isolation of cases and anti-sputum precautions are required for one and milk-precautions for the other. I only mention it to show that the advocacy of either one or the other measure would be by itself insufficient.

The prevention of tuberculosis must depend, like the prevention of other bacterial diseases, on close and accurate knowledge of the processes underlying the pathogenesis of the disease. . . . Do we now possess all the necessary knowledge? No. We have yet to learn some of the essentials of prevention. We have made great progress. We have found several of the lines along which prevention must proceed. There is much good knowledge that is not yet in use; that has not yet been accepted from the laboratory worker by the clinical worker, because it seems to clash with widely accepted views. But it must be admitted that we still lack knowledge on some of the essential points, and that further research is still required before prophylaxis can be made as effective as it is in, say, Malta fever.

And there is the still greater difficulty that some of our most certain knowledge is very difficult to apply.

With these considerations before us we begin to realize that the answer to King Edward's question may not be far to seek.

Let us first set out for discussion the main points in connection with prevention about which we have no doubt at all:—

(1) We know that tuberculosis in man is caused by two types of tubercle bacillus—the “human” and the “bovine.”

(2) We know the sources from which these bacilli are distributed into the outside world.

(3) We know that if we could control these sources of infection, there would be an end of the disease. We know other things as well; but let us for a moment consider these three big facts, all of which are beyond dispute and the application of which would seem to promise success in preventing the disease. “If preventable, why not prevented?”

Let us turn back for a moment to facts (2) and (3): the sources of human and bovine bacilli and the need to control them. As for the human type, the main source is the sputum and the cough-spray of infected persons. Here we are at once reminded of pneumonic plague, where the source of infection is much the same and where isolation of cases has given such good results. Think for a moment of the two diseases: one an acute and rapidly fatal illness that lasts a

short time and the severity of which prevents any possibility of the patient mixing with his fellows, beyond the members of his own household ; the other a disease which cannot be diagnosed until it is fairly advanced, that may last for years, that often permits the victim to work, marry, beget children, and assume all the responsibilities of an ordinary citizen. We know that his presence among us is a danger, but how is he to be isolated? Who is to support his family while he is placed under durance? And what about the large proportion of infective persons that must always escape diagnosis? The adequate control of this source of infection is beyond our power. Much can be done, much is being done ; but we all know that the number of infective people at large will always remain greater than the number isolated in our hospitals and Sanatoria. *We know what to do but we cannot quite do it.* So much, then, for controlling the sources of the human type of tubercle bacillus. But surely we can at least deal with the bovine. By the boiling of goat's milk or by avoiding its use, it was found a simple matter to stamp out Malta fever as a disease of British troops in Malta. Why not do the same for cow's milk in England? We had to cater for a population that was chiefly an adult one in Malta. The adult does quite well on boiled milk because he uses a mixed diet in which a deficiency in one item is made good in another. And for the small number of European children in Malta, it was a simple matter to substitute cow's milk for goat's milk and thus to avoid much of the danger of Malta fever. But the problem of bovine tuberculosis in England is a far more difficult one. Cow's milk is the principal article of diet for a large majority of infants and young children to-day in this country. It is collected and distributed in a manner that leaves much to be desired. It is much more dangerous as a cause of infantile diarrhoea than as a cause of tuberculosis, though it probably accounts for nearly a tenth part of the mortality from the latter. It is very hard to control for several reasons. It is enough, for the moment, to say that *while every one is agreed as to the urgent need of a cleaner milk supply we have so far failed to obtain it.*

In the control of sources of infection, we have the problem in its most vital and fundamental form, and yet we have to admit that our measures are, and, in some respects, must remain, inadequate. Is the problem, then, an insoluble one? By no means. Nature is quietly solving it for us and, in doing so, she is teaching us how we can help her to expedite the process. Tuberculosis is getting milder and milder in type. The death-rate is steadily falling. Even the awful conditions of the late war only led to a temporary increase. We may look forward with confidence to the day when this scourge will be a matter of history like leprosy, its close relative, once the most dreaded of all diseases in this country. How can we bring that day nearer?

At this point we must return to the enumeration of the things that we know about tuberculosis.

(4) We know that certain persons are much more susceptible to infection than others. Infants and young children are more susceptible than European adults. Females brought from the shelter of domestic surroundings are often found to be very liable to infection, especially during adolescence. Persons of all ages and sexes migrating from the isolation of rural life to the big centres of industry are said to run a considerable risk of contracting the disease. All these classes have one thing in common ; they have not had much previous contact with the germ.

Thus it comes about that they are often without any effective power of resisting it and, though in good health, are found to be very liable to infection.

(5) We know that mild and latent infection is widespread in our large centres of population and that, where this is the case, the clinical type amongst those suffering from tuberculosis tends to be chronic rather than acute, and the mortality of the middle-age type.

(6) We know that much of the tuberculosis of adult age, at least in our towns, is the result of infection contracted long before, probably in childhood.

(7) We know that certain trades, especially those involving exposure to silica dust, are closely associated with a high phthisis mortality; and that faulty physiological conditions of life lead to the development and progression of infections that might have otherwise remained latent.

Now these facts, if properly interpreted, give us the key to many practical measures for the prevention of this disease. To begin with, they enable us to divide roughly our communities and individuals into two classes: the relatively susceptible and the relatively resistant.

It is obvious that, in our efforts to prevent the spread of the germ, we shall be wise to concentrate especially upon protecting those who are most liable to infection. Exposure of such a slight degree as to be without danger to a resistant adult may prove fatal to a child. I recently saw a little Indian girl of 13 years old who had been brought from a village in the Bombay Presidency seven months before to be educated in Cardiff. Three months ago she began to lose weight. She is now dying from acute general tuberculosis. This extreme case points a moral of general applicability: our main efforts to guard against infection must be directed to protecting young children, new arrivals in our midst, who are as yet unprovided with the resistant powers that we all acquire as we grow up and take our places in human aggregations.

The risks that infants and young children run are chiefly in their homes. There are two sources, the parents and relatives, and the milk that is used as their food. In cases where the parents are suffering from advanced tuberculosis of the lungs it is best to separate the children from them or isolate them from the children. The wonderful results of the Grancher system, as applied in France, show what may be done in this direction. But it is a very serious thing to separate parent and child and, in all cases where the parents are in fair health, well-to-do and intelligent, it is probably better to teach them how danger may be avoided and let them fight their own battle. Here it is that general methods of hygiene, such as fresh air, clean houses, open windows, plenty of sunlight and suitable food are so applicable, and where the spread of knowledge by propaganda is likely to do so much good. Then, again, there is the question of the susceptible adults or adolescents who leave country homes to seek work in the cities. Such persons ought to be made to realize that their life may depend upon the kind of work which they accept and the kind of people with whom they are thrown. The young domestic servant from the country who enters a house in which there is an open case of tuberculosis runs a grave risk. This kind of advice, though of real importance, is much less often given than the equally important kind that suggests open windows.

Turning from these highly susceptible groups to the groups that have an acquired resistance, the adult inhabitants of our large towns who constitute such

a big proportion of the population of England and Wales to-day, we have a problem which is in many respects very different. Here we deal with persons who, for the most part, are already infected ; persons who, though in fair average health, have foci of tuberculosis in their tissues, and who, in the course of each day, are almost certain, owing to the conditions in which they live, to inhale or ingest a certain number of tubercle bacilli. It is exceedingly difficult to reinfect a person already infected. Baldwin's work with guinea-pigs makes this quite clear. The danger that these people run is not so much fresh infection from outside but massive infection from within. While the existing foci remain latent, all is well ; but there is the risk that bad conditions of environment, unsuitable housing, poor food, indoors work in crowded rooms, low wages and anxiety may so reduce the resistance that the latent foci become active and serve as centres from which the tissues are still further infected. Here our methods of prevention should be directed not only to the prevention of infection—there is not so much risk of that—but to the bettering of the environment, to the protection of the individual from the dangerously large auto-inoculations that may occur if his life is too hard. We have only to look at the low death rate and the relatively mild clinical type of tuberculosis amongst the well-to-do to realize the direction which our efforts should take. Think of the plight of the working man upon whom falls the whole support of his wife and children and who feels his health going. If only he could rest for a while, take a holiday, forget about the rent, get a good change of air, he would soon be fit for work again and could work on for years until all the children were educated and independent ; but back to work he must go or see them starve ; and can we wonder that he takes little notice of the advice of his doctor but just struggles on till the inevitable breakdown comes and he can work no more ? Had he been a bit better off his tuberculosis would have remained latent and harmless. As it is, he has reached a stage at which recovery is impossible. Society has a duty to such men. The cure is better education, better opportunities, better wages. Society has nothing to fear from the self-respecting workman. It has everything to fear from the desperate and hopeless victim of circumstances who finds all doors closed to him, all work beyond him, his health gone from him and nothing but ruin and starvation for him and his children. We must recognize, as a nation, that a high standard of living is necessary for a high standard of output ; that a high standard of output is necessary for high wages ; that high wages are necessary for a high standard of living. It is a circle which can be either beneficent or vicious.

Tuberculosis as we meet it in the great centres of our western civilization is a *social disease*. Its eradication depends upon factors that can be appreciated but not entirely controlled by the medical profession. In hearty co-operation between employers and employed, each alive to the interests of the other as well as to his own, lies the only hope. Well-paid, well-fed men free from the awful anxiety of unemployment and sure of continued work are not likely to suffer much from tuberculosis even though they may have foci of infection in their bodies. Nature is at work in our favour. The death-rate was falling long before our measures of sanitation were brought to an appreciable degree of efficiency. One of the clearest indications is to help nature in her work by making the hard lot of the poor a little less hard.

Current Literature.

Influenza and Catarrh: Experience of Prophylactic Inoculations.—

(1) The Sydney (N.S.W.) Epidemic of 1919 (Department of Public Health Report, *Brit. Med. Journ.*, October 16, 1920). By retrospective investigation (ascertaining the proportion of patients undergoing attacks who received prophylactic inoculations, regard being had to the comparative mortality among the uninoculated, partially inoculated and completely inoculated), it was found that of 12,000 treated in hospitals :—

6,249 uninoculated showed a mortality of	..	..	16.5 per cent.
705 inoculated once	..	..	11.1 "
2,273 " twice	..	..	10.1 "
605 " three times	..	..	8.2 "

The first case in this epidemic arrived from New Zealand in October. Notification, isolation of patients, and contacts, *prohibition of assemblies*, compulsory masking in public places and severe restrictions on travelling, together with prophylactic inoculation, checked the development of the epidemic for three months and afterwards prevented it from assuming the explosive character seen in many other countries.

The evidence of the Sydney epidemic was against the spread by carriers. In no case was the infection observed to be conveyed by those who had been discharged from quarantine, while still harbouring Pfeiffer's bacillus in their throats. The Director General of Public Health does not hesitate to advise inoculation at fairly short intervals, should the state again be threatened with an invasion approaching in virulence that of 1919.

(2) Von Stolly and W. Park. Report of the Prophylactic Inoculation of 1,536 persons against acute Respiratory Diseases, 1919-20, *Bulletin Inst. Pasteur*, and *Journ. of Immunology*, January 21: 1,327 persons received three inoculations at weekly intervals and were observed over a period of six months with the following results: 13.7 per cent had no respiratory affection. Of 3,025 not inoculated, who lived under analogous circumstances, 29.75 per cent. showed no respiratory affection during the same period, but the cases of pneumonia were less frequent among the inoculated—(one case as against 11 cases).

(3) Dr. Haythorn, of Pittsburg University, in his studies on epidemic influenza, points out that comparisons of the incidence and mortality among the inoculated and uninoculated are most valuable when vaccinations have been completed before the epidemic. In one observation, carried out under these circumstances (vaccine given three weeks before the appearance of the first case) the case incidence was 9.8 with 1.2 per cent deaths among the uninoculated, and 1.2 per cent with no deaths among the inoculated. The community observed was a hospital of 1,000 patients and 300 employés. There was an indication that the use of vaccine prior to the arrival of the epidemic may lessen the incidence and severity of pneumonia. This is in accordance with the conclusions of Eyre and Lowe (*Lancet*, April 5, 1919).

(4) Minaker and Irvine (*Journal of the American Medical Association* for March 22, 1919) report only 35 cases with 1 death among 1,950 marines released from quarantine immediately after completion of their inoculation and turned into San Francisco, where influenza was at its height. Among a control group of 8,232 uninoculated, there were 1,296 cases of influenza with 65 deaths. Among another series of 3,514 inoculated men released from quarantine, in the midst of an epidemic, fifteen only had the disease and there were no deaths.

Tularæmia,¹ a Disease hitherto undescribed.—In recent years there has occurred among the rural population of Hillard County, Utah, U.S.A., a disease known locally as deer-fly fever. It is caused (according to popular belief) by the bite of a fly and is manifested by the enlargement and frequently the suppuration of the lymph glands which drain the area of the bite. It is marked by fever of a septic type and occasionally ends fatally.

The disease has been investigated by Francis who demonstrates as the causal agent *Bacterium tularensis*, an organism identified and described in 1912 by McCoy and Chapin as the cause of a plague-like disease in rodents. Francis proposes the name tularæmia for the disease.

In nature the disease is found in ground squirrels and jack rabbits, and experimentally guinea-pigs, rabbits, mice, sheep and monkeys were found highly susceptible. Rats are moderately susceptible, but cats, dogs, pigeons, calves, goats and pigs appear insusceptible.

Experimentally the disease was transmitted by the bites of the blood-sucking fly (*Chrysops discalis*), the stable fly (*Stomoxys calcitrans*), the bed-bug (*Cimex lectularius*), the squirrel flea (*Ceretophyllus acutus*), the rabbit louse (*Hæmodipsus ventricosus*), and the mouse louse (*Polyplax serratus*).

During the investigation of the disease the entire laboratory personnel (six), who were employed continuously in handling or dissecting infected rodents, contracted the disease, although all were fully experienced in investigating and handling infected materials.—(Lake and Francis.)

B. tularensis is described as a capsulated rod 0.3-0.7 micron in length by 0.2 micron broad. It is negative to Gram and stains poorly with the ordinary bacterial stains, aniline water, Hoffman's violet being stated to give the best results. It does not grow on the ordinary laboratory medium, but on Dorset's egg medium forms transparent opalescent drop-like colonies in three to five days. It is isolated by injecting the infective material into guinea-pigs, rabbits or mice, which invariably die, cultures then being made from lymph glands, spleen or liver. Post-mortem the animals show caseated lymph glands and small necrotic foci throughout the liver and spleen.

It is understood that there is no culture of *B. tularensis* in the national collection of type cultures, but that one has been asked for and promised.

The recorded cases in human beings fall into two clinical groups, the first severe, the second mild.

Of 8 cases reported as occurring naturally (7 reported by Francis and 1 by Wherry and Lamb) 7 showed evidence of infection by a bite and 1 appeared to have been infected by rubbing the eye with a contaminated hand. The incubation period was twenty-four hours in the only case in which the date of infection was recorded. The onset is sudden with pain in the locality of the bite as well as headache and backache. The temperature is from 101° to 103° F. in the evenings with morning remissions of one or two degrees. An ulcer forms at the locality of the bite and the superficial lymph glands draining the area become swollen and painful. One or more of the glands usually suppurate. The fever lasts for from three to nine weeks, and recovery is the usual result, but with slow convalescence. One of the cases reported terminated fatally. *B. tularensis* was isolated from the blood of two cases and from the pus of the local lesion in others.

The second clinical type of the disease was seen in six cases which occurred among the laboratory personnel. In these cases there was no evidence of inoculation through the broken skin, and there was absence of any involvement of the superficial lymph glands. All cases had an evening temperature of 102° F. or slightly higher, with morning remissions of one or two degrees. The temperature subsided gradually over a period of three weeks. Most of the cases suffered from shifting pains in the muscles and joints, and in some these persisted for many months. Other symptoms observed were sore throat on the sixteenth day,

¹ Extracted from the literature by Lieutenant-Colonel S. P. Jarvis, for Ministry of Health.

dizziness, rhinitis and slight epistaxis, localized hyperæsthetic area of skin, mild tympanitis and nausea.

Blood taken from three of the above cases during the febrile stage and injected into guinea-pigs gave negative results. The final diagnosis of the disease, therefore, rests on serological evidence. Positive serum reactions were obtained for agglutination and complement fixation to antigens composed of *B. tularensis*. Negative controls were performed with sixty-six sera, for the most part from non-febrile hospital patients. Two or three of these gave some degree of positive complement fixation action, but were negative by the agglutination test. The authors point out that the controls should have been from patients in the febrile stage of some known disease, but state that such were not available. The serum from one of the affected laboratory assistants had been used as a control with negative results, prior to his infection, the reactions subsequently being positive.

One of the patients, who had a mild attack, was killed in a railway accident shortly after his recovery and about ten weeks after the onset of the disease. A complete post-mortem examination failed to show any evidence of lesions of tularemia, either active or healed. All the organs and tissues were normal except for the crushing injuries caused by the accident.

About eighteen months after the onset of the disease, one of the patients, who continued handling the infective material, had some cracks in his hands. He noticed a tender red papule on his finger and the same night noticed enlarged and tender lymphatic glands in the corresponding epitrochlear and axillary region which lasted for seven days. There was no rise of temperature and no constitutional disturbance. Blood taken from the median basilic vein on the seventh day was injected into six guinea-pigs with negative results. On the second day of the attack the papule on the finger was incised. No pus was found, but blood from the incision was injected into the guinea-pig with a positive result.

Lake and Francis suggest the possibility of the existence of unrecognized cases of the mild type of the disease. As an instance of this they refer to the work of McCoy and Chapin who reported in 1912 agglutination and complement fixation to *B. tularensis* antigens not only in the sera of naturally or artificially immune animals, but also in two out of eleven human sera tested. The two positive human sera were from Dr. Chapin and a laboratory attendant, both of whom were extensively engaged in handling or dissecting infected rodents. When his attention was called to the six cases of laboratory infection some years later, Dr. Chapin stated that shortly previous to testing his own serum in 1912, he had a febrile attack which kept him off duty for about three weeks and which was unaccompanied by glandular enlargement or other local lesion. He was unable to recall any absence from duty on the part of the laboratory attendant.

The same authors (Lake and Francis) state that positive serological reactions are known to persist for two years after an attack, and they suggest that routine tests would probably bring to light unknown foci of infection, and might throw light on the ætiology of fevers of undetermined origin. This suggestion would apply equally to this country, where susceptible animals and biting insects capable of transmitting the infection are common, especially in view of the occurrence from time to time of septicæmia following insect bites, occasionally with a fatal termination. So far as is known no bacteriological reports of such cases have been published, and, considering the difficulty of isolating and identifying *B. tularensis* without animal experiments, it is quite conceivable that infection by this organism has been overlooked.

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Notices.

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THE EUGLOBULIN GROUP AND ITS RELATIONSHIP TO
THE WASSERMANN REACTION.

BY BREVET MAJOR C. H. H. HAROLD.
Royal Army Medical Corps.

IN early 1913, under orders of the D.M.S. India, a laboratory for the performance of the Wassermann reaction and other work in relation to venereal disease was opened in Ambala. At that time the test commonly employed in India was Flemming's modification, which, depending upon the natural human complement present in a serum, gave rise, at times, to variable and fallacious readings, especially in the case of sera which had travelled long distances in a warm climate. It was also generally stated that malaria in certain instances seriously vitiated the results.

A rabbit anti-sheep amboceptor prepared in England was found to be very poorly effective against Indian sheep's cells, and a rabbit anti-goat serum was prepared. Guinea-pig serum in India was invariably found to be poorer in complement than is the case in England. A demonstration of Harrison's modification at the Research Institute, Kasauli, resulted in its adoption in these laboratories as the standard test and for some time an exchange of sera and reagents took place for the purposes of comparison with extremely satisfactory results. It was initially laid down that in submitting sera to the Northern Army Laboratory for testing, the date of the last attack of malaria should be noted on the card and no serum should be sent which had been taken during a pyrexial period. As a result of these simple precautions in no instance could it be demonstrated that malaria exercised any disturbing influence upon the test although many thousands of specimens were examined, coming from districts as far apart as Calcutta

84 *The Euglobulin Group and the Wassermann Reaction*

and Peshawar, and also taken from many men who were undoubtedly latent malarial carriers. One of the greatest bugbears in carrying out the tests proved to be bacterial contamination of the specimens by which the serum during transit was frequently converted into a thick yellowish puriform fluid.

At this time attached to the laboratory were two orderlies with histories of malaria. Their sera had been used as negative controls in the Wassermann test and they had no signs of syphilis.

In April, 1914, orderly No. 1 developed malaria which proved to be benign tertian, and his serum during the attack gave a (+) Wassermann reaction (a deviation of 3 M.H.D. of complement). He was given quinine; within four days his paroxysm was over, his blood gave a (±) reaction and at the end of a week became a clean negative.

A month later orderly No. 2 developed a serious attack of malaria with fever of a continuous type. Examination of blood films revealed a very heavy infection of malignant tertian malaria, and that larger benign tertian rings were also present. His serum was tested and gave a (++) reaction, or deviated four hæmolytic doses of complement. This orderly volunteered the abstraction of a large quantity of blood, half of which was drawn into a sterile flask and allowed to clot and the other half into citrate solution. The citrated blood was centrifuged and the cells twice washed with normal saline solution. The washed cells freed from saline by centrifugalization were then put into a thermos flask and alternately frozen and thawed, in order to break them up, and also their contained parasites. These cells were extracted with alcohol, using the same proportions as employed in making the ordinary alcoholic heart extract. The patient was given quinine and made satisfactory progress. A spleen from a fatal case of malaria had been received from Captain R. F. Bridges, Peshawar, and an alcoholic extract of the spleen pulp had been made.

Blood serum from the malarial patient was then put up as for a Wassermann test, using the extract of cells, extract of malarial spleen and the usual cholesterinized heart extract as antigens.

It was found that the cell antigen gave a (±) reaction against malarial serum, the spleen a (+) and the cholesterinized heart extract (++).

Putting up florid syphilitic blood serum against these antigens the cell extract gave (-), the spleen extract (+), and the usual cholesterinized heart extract (++) . The addition of cholesterin solution to the spleen antigen raised the deviating power of this antigen to (++) , both against syphilitic serum and malarial serum. Tests carried out with the malarial patients' serum proved that as the febrile paroxysm defervesced and the number of crescents diminished the reaction became correspondingly reduced, by the tenth day it had diminished from (++) reaction = (a deviation of 4 M.H.D. complement) to a (±) against 3 M.H.D. At the end of a fortnight the blood serum gave completely negative results. The

serum from the sample of malarial blood which had been drawn into the sterile flask was separated from the clot and heated in the ordinary way to diminish anti-complementary action. On testing it proved to be non-anti-complementary. Samples of serum from florid syphilitics were pooled, treated in the same way and also proved to be non-anti-complementary.

After half saturation of both of these types of sera with ammonium sulphate precipitates of the globulin group were obtained and dissolved in an amount of saline equal to half the original bulk of serum. On testing, the malarial globulin solution in a 1 in 5 dilution deviated 6 M.H.D. of complement and the syphilis solution 8 M.H.D., using cholesterinized heart extract as the antigen. There was a slight increase in the anti-complementary powers of these solutions compared with the ordinary untreated sera.

In 1915 on my departure over-seas the Northern Army Laboratory was closed. The results of the above experiments seemed to indicate that: (1) Under certain conditions it was possible to get a strong Wassermann reaction in malarial cases during a paroxysm; (2) that the ordinary precautions as stated above eliminated this fallacy; (3) that extracts of malarial organs did not act as specific antigens against malarial sera but acted equally well against syphilitic sera; (4) that the usual syphilitic antigens acted equally well against malarial sera; (5) that both the Wassermann substances due to malaria and syphilis came down in the globulin group and were to a certain extent capable of concentration without becoming unduly anti-complementary.

Further experiments in regard to the globulin group could not be carried out until recent times owing to the absence of facilities.

As salting out methods had not proved to be entirely satisfactory in India, on recommencing it was decided that attention should be directed to dilution and acidulation methods which would yield cleaner precipitates, using salting out methods as a control.

It was realized that an enormous amount of work had been done on this test of late years, but an examination of the literature which has been so well summarized and criticized in the Reports on Public Health and Medical Subjects [1] No. 1 failed to reveal that a critical examination of the euglobulin group employing a combination of methods had been carried out.

It is known that one-third saturation of a serum with ammonium sulphate throws down the main euglobulin group, that half saturation throws down the main pseudo-globulin group, two-third saturation brings down part of the albumins and complete saturation all the albumin group. In addition each of these divisions is not absolute and that usually a little of one group is carried over into the next one. It is also well known that dialysation throws down part of the euglobulin group, that the passage of CO_2 through a dilute solution of serum precipitates a second fraction of

86 *The Euglobulin Group and the Wassermann Reaction*

euglobulin, and that further acidulation with dilute acetic acid throws down a third fraction of this same group. With these different points in mind experiments were planned to investigate the properties of these different fractions and their relationship to the Wassermann reaction.

The sera used for these experiments were invariably pooled specimens heated at 56° C. for half an hour and had given known reactions in the hands of the pathologist to the Venereal Clinic at St. Thomas's Hospital. The technique and the reagents employed were identical with the ones used for the original testing of the sera.

GROUP (1) EXPERIMENTS.

Sera with reactions (-), (+), (++) were thrown into varying quantities of distilled water, i.e., 1 cubic centimetre of serum to 9 of distilled water, and 1 cubic centimetre to 19 of distilled water. A drop of 2 per cent acetic acid was added to each tube and the amount of precipitate after centrifugalization noted.

Observation 1: A more complete precipitation occurred when the greater dilution of distilled water was used, i.e., one cubic centimetre to nineteen cubic centimetres water.

Observation 2: Using a 1 in 20 dilution with the (-), (+), (++) sera differences in the opacities of the various solutions were very noticeable, the (++) having the greatest opacity, the (+) a less degree of opacity, and the (-) being still less opaque. On centrifugalization the amount of precipitate obtained from the (++) sera was greater than from the (+) or (-) sera.

Observation 3: After treatment of the above with acetic acid and distilled water and the removal of the euglobulin by centrifugalization one-third saturation of the supernatant fluid with ammonium sulphate yielded no precipitate, showing that all the euglobulin group had been thrown down. Half and two-thirds saturation of the sera in successive stages yielded the usual precipitates.

GROUP (2) EXPERIMENTS.

Taken four cubic centimetres of (+) serum, one-third saturated with ammonium sulphate. Centrifuged down = precipitate (1).

Supernatant fluid from above, half saturate with ammonium sulphate. Centrifuge down = precipitate (2).

Dissolve (1) and (2) in one cubic centimetre of distilled water = solutions (1) and (2).

Complement titrated working at 1 in 60.

Putting up solutions (1) and (2) against complement.

		Complement dilution :									
		1 in 10		1 in 20		1 in 30		1 in 40		1 in 60	
Solution (1) diluted	1 in 5	..	+	..	+	..	+	..	+	..	+
" (2) "	1 in 5	..	-	..	+	..	+	..	+	..	+

+ = no hæmolysis. Solutions markedly anti-complementary.

Taken 2 cubic centimetres of the same (+) pooled serum, added to 33 cubic centimetres distilled water containing 3 drops of 2 per cent acetic acid.

Precipitate centrifuged down and dissolved in one cubic centimetre of saline = solution (3). The ordinary (+) untreated serum = solution (4).

Put up against complement dilution :		1 in 10	1 in 20	1 in 30	1 in 40	1 in 60
Solution (1) in 1 in 9 dilution	..	—	..	—	..	+
" (2) " "	..	—	..	—	..	+
" (3) in 1 in 5	..	—	..	—	..	+
" (4) " "	..	—	..	—	..	+

Solutions (1), (2), (3), (4). Put up as for a Wassermann test. (1) and (2) in 1 in 9 dilution, (3) and (4) in 1 in 5 dilution.

Complement in :		1 in 25	1 in 15	1 in 10 dilutions
Solutions (1)	..	—	..	—
" (2)	..	±	..	—
" (3)	..	+	..	—
" (4)	..	+	..	—

Interpretation of Results.—Precipitates (1) and (2) were anti-complementary when put up in concentrated strength. The optimum dilution was the strength that these globulins normally have in serum diluted 1 in 5. These precipitates were dissolved in distilled water and not saline because it was thought that the amount of ammonium sulphate attached to the precipitates would be sufficient for the purposes of tonicity and if saline was not used no increase in anti-complementary action would take place. However, it is seen that under these conditions no complement is deviated by these groups.

No. (4) is the untreated serum and it is seen that No. (3) which is the euglobulin group precipitated by acid is not more anti-complementary than an untreated diluted serum, although the euglobulin is in double the strength in which it is present in blood serum. On account of the concentration it is noteworthy that solution (3) gives a (++) reaction whereas the original serum gives (+) reaction.

GROUP (3) EXPERIMENTS.

Pooled sera having (—), (±), (+) (++) reactions were taken and treated by the dilution acetic acid method, and the precipitated euglobulin group was put up in double the strength that it is normally present in blood serum. In addition the (++) serum was fractionally saturated one-third and one-half with ammonium sulphate and the resulting precipitates dissolved in an amount of distilled water equal to the original volume of serum.

All these solutions were put up in 1 in 5 dilutions against complement with the following results:—

Complement working 1 in 50 :		Solution of euglobin from pooled sera				(++) ½ sat.	(++) ½ sat.	Untreated serum
Serum		(—)	(±)	(+)	(++)			
Complement dilutions 1 in 15		—	—	—	—	—	Dirty	—
" " 1 " 20		—	—	—	—	—	"	—
" " 1 " 30		—	—	—	—	—	"	—
" " 1 " 40		±	±	±	±	Dirty	"	±
" " 1 " 50		±	±	±	±	"	"	±
" " 1 " 60		±	±	±	±	"	"	±

88 *The Euglobulin Group and the Wassermann Reaction*

The above sera were now put up with antigen as for a Wassermann, using complement 1 in 10, 1 in 15, 1 in 25 dilutions.

Sera	-	±	+	++	$\frac{1}{2}$ sat. ++	$\frac{1}{2}$ sat. ++
Complement 1 in 10	-	-	-	+	-	-
„ 1 „ 15	±	±	±	+	-	-
„ 1 „ 25	±	±	+	+	-	-

Interpretation of Results.—The ammonium sulphate fractions gave non-distinctive dirty reactions when titrated against complement. When put up with antigen even though they were precipitated from (++) sera they deviated no complement.

The euglobulin fractions precipitated from sera by dilution acetic acid methods showed no evidence of increased anti-complementary powers although the euglobulin group was put up in twice its precipitable strength. The euglobulin fraction from the (-) serum gave (±) against a 1 in 25 dilution of complement and (±) against a 1 in 15 dilution, but it must be borne in mind that these sera are from treated cases of syphilis, and by concentrating the euglobulin fraction we have tended to raise the complement deviating power of any doubtful serum contained in this pooled serum.

The (±) euglobulin fraction gave (±) results.

The (+) euglobulin fraction deviated 1 in 25 complement and gave a (±) against 1 in 15 complement. The original (+) serum from which this group was precipitated gave (+) against 1 in 25 complement, and a (-) against 1 in 18 complement. So that here again there is evidence of increased deviation.

The optimum degree of acidity which favoured the precipitation of these globulins was now investigated, and as the ammonium sulphate fractions of (++) sera when put up in distilled water did not deviate complement, it was decided to put them up in saline in future.

GROUP (4) EXPERIMENT.

Taken (-) (treated cases) and (++) pooled sera. Two cubic centimetres of (++) serum were taken and one-third saturated with ammonium sulphate. Precipitate dissolved in one cubic centimetre saline = solution (A), supernatant fluid from above half saturated with ammonium sulphate.

Precipitate dissolved in one cubic centimetre saline = solution (B).

Supernatant fluid from above two-thirds saturated with ammonium sulphate.

Precipitate dissolved in one cubic centimetre saline = solution (C).

The original (-) serum, (++) serum, and (A), (B), (C) solutions in 1 in 5 dilutions were put up against complement as below. In addition the euglobulin fractions precipitated by dilution acetic acid methods from (++)

serum and from (—) serum were dissolved in double strength and also put up against complement.

Complement working 1 in 45.

Sera 1 in 5	Serum (—)	Euglobulin fraction (—)	Serum (++)	Euglobulin fraction (++)	(A)	(B)	(C)
Complement 1 in 10	—	—	—	—	—	±	+
„ 1 in 20	—	—	—	—	—	+	+
„ 1 in 30	±	±	±	±	+	+	+

0.5 cubic centimetre (++) serum added to 10 cubic centimetres distilled water + 0.025 cubic centimetre of 2 per cent acetic acid. Centrifuge. Precipitate dissolved in 0.25 saline = (1).

0.5 cubic centimetre (++) serum added to 10 cubic centimetres distilled water + 0.05 cubic centimetre of 2 per cent acetic acid. Centrifuge. Precipitate dissolved in 0.25 saline = (2).

0.5 cubic centimetre (++) serum added to 10 cubic centimetres distilled water + 0.075 cubic centimetre of 2 per cent acetic acid. Centrifuge. Precipitate dissolved in 0.25 saline = (3).

0.5 cubic centimetre (++) serum added to 10 cubic centimetres distilled water + 0.125 cubic centimetre of 2 per cent acetic acid. Centrifuge. Precipitate dissolved in 0.25 saline = (4).

0.5 cubic centimetre (—) serum added to 10 cubic centimetres distilled water + 0.05 cubic centimetre of 2 per cent acetic acid. Centrifuge. Precipitate dissolved in 0.25 saline = (5).

On the addition of the acid to (1) and (2) it was noted that a fair precipitate appeared at once, with No. (3) there was a little delay, and in the case of No. (4) considerable delay. After centrifugalization it was noted that (1), (2) and (3) were the usual sticky euglobulin precipitates which dissolved slowly in saline giving an opalescent solution. No. (4) was a hard, flaky deposit which required breaking up in saline before it would dissolve and the solution had a granular appearance due to undissolved particles. All these groups were put up in increasing dilutions with antigen as for a Wassermann, using 3 M.H.D. complement.

Dilutions of solutions :			1 in 5	1 in 10	1 in 20	1 in 40	1 in 60	1 in 80	1 in 120
No. (1)	+	+	+	±	±	—	—
„ (2)	+	+	+	±	—	—	—
„ (3)	+	+	+	—	—	—	—
„ (4)	+	—	—	—	—	—	—
„ (5)	+	±	±	—	—	—	—
(A)	+	+	±	—	—	—	—
(B)	+	+	±	—	—	—	—
(C)	+	±	—	—	—	—	—
(++) Untreated serum			+	+	+	±	—	—	—

* Saline controls not hæmolized owing to AC but hæmolysis in tubes of higher dilutions marked —.

Interpretation of Results.—It is seen in the titration against complement that the untreated (++) and (—) sera are not anti-complementary, and that the euglobulin fractions separated from them are also not anti-complementary. Using salting out methods fraction (A) is a little anti-com-

plementary, fraction (B) much more anti-complementary and (C) very strongly so.

On putting up the above solutions in increasing dilutions with antigen against 3 M.H.D. complement it is noted that the greatest deviation is given by solution (1), in which the euglobulin group is precipitated by 0.025 cubic centimetre of 2 per cent acetic acid per 10 cubic centimetres distilled water + 0.5 cubic centimetre of serum. The addition of 0.125 cubic centimetre of acid per 10 cubic centimetres causes the euglobulin to be altered in appearance and solubility, and also the Wassermann bodies to disappear to a large extent. No. (5) is from (-) serum, but we must remember that it is a concentrated euglobulin group from treated cases of syphilis. Fraction (A) shows the presence of Wassermann bodies. Fraction (B) as proved in the preliminary titration against complement is frankly anti-complementary, and fraction (C) is more so. The idea that certain people hold that the half and two-thirds saturation fractions contain larger amounts of Wassermann bodies would appear to be incorrect and that the real explanation is that they are increasingly anti-complementary, and, apart from fraction (A) = (the euglobulin group), fractions (B) and (C) appear to contain no Wassermann substances.

GROUP (5) EXPERIMENTS.

In continuation of group (4) experiments the supernatant fluid remaining after centrifuging down precipitate (1) was one-third saturated with ammonium sulphate and no precipitate was thrown down, showing that all the euglobulin fraction had been removed by the acid and distilled water method. It was now half saturated and a precipitate (X) resulted. This was centrifuged down and dissolved in 0.25 cubic centimetre of saline. Precipitate (X) in 1 in 5 dilution was titrated against complement and gave a (\pm) reaction against 1 in 15 complement, showing that it was anti-complementary.

The following groups were then put up with antigen as for a Wassermann test in 1 in 5 dilution. Complement used in 1 in 10 dilution.

	Groups									
	(1)	(2)	(3)	(5)	(A)	(B)	(C)	(-)	(++)	(X)
1 in 10 complement	+	+	+	\pm	\pm	\pm	\pm	-	+	\pm

Interpretation of Results.—This particular complement was not very active and only worked at 1 in 45. The putting up of these groups against a 1 in 10 dilution of complements confirmed the results obtained in the preceding experiments and also indicated that the group globulin obtained by half saturation after acid and distilled water precipitation of the euglobulin contained little or no Wassermann substances and appeared to be solely anti-complementary.

GROUP (6) EXPERIMENTS.

Taken (-) pooled sera and (++) pooled sera from florid cases showing signs. 0.5 cubic centimetre (-) serum. Euglobulin precipitated by acid and distilled water. Precipitate dissolved in 0.3 cubic centimetre = (A).

Supernatant fluid of above = 1 in 20 of serum in distilled water made up to tonicity of blood = (B).

0.5 cubic centimetre (++) serum treated as (-) serum above. Euglobulin dissolved in 0.3 cubic centimetre saline = (C).

Supernatant fluid of above = 1 in 20 serum in distilled water, made up to tonicity of blood = (D).

0.5 cubic centimetre (++) serum diluted with distilled water 1 in 20 and CO₂ bubbled through. Precipitate dissolved in 0.3 cubic centimetre saline = (E).

Supernatant fluid of above = 1 in 20 serum made up to tonicity of blood = (F).

The untreated (-) serum = (G).

The untreated (++) serum = (H).

The above were put up in increasing dilutions with antigen as for a Wassermann test against 3 M.H.D. complement = 1 in 13.

Dilutions of solutions:	1 in 5	1 in 10	1 in 20	1 in 30	1 in 40	1 in 60	1 in 80	1 in 120
(A)	—	—	—	—	—	—	—	—
(B) Solution is 1 in 20	—	—	—	—	—	—	—	—
(C)	+	+	+	+	+	—	—	—
(D) Solution is 1 in 20	—	—	—	—	—	—	—	—
(E)	+	+	+	—	—	—	—	—
(F) Solution is 1 in 20	+	+	+	—	—	—	—	—
(G)	—	—	—	—	—	—	—	—
(H)	+	+	+	+	—	—	—	—

Interpretation of Results.—The above indicates that all the Wassermann bodies are precipitated by the acetic acid, distilled water method and are confined to the euglobulin fraction. CO₂ is an inferior precipitant of these bodies but by using a larger dilution of distilled water we are able to precipitate a larger quantity of the group than Griffith and Scott did, employing only a 1 in 10 dilution of serum with distilled water.

Comparing the readings of groups (C) and (H) it is seen that group (C) is the euglobulin group precipitated from 0.5 cubic centimetre of serum (H), dissolved in 0.3 cubic centimetre distilled water, and (H) is the ordinary untreated (++) serum. The effect of precipitating the euglobulins from 0.5 cubic centimetre of serum and dissolving them in 0.3 cubic centimetre of saline is to increase the reaction by making group (C) deviate complement in a 1 in 40 dilution instead of a 1 in 30 dilution as in (H).

GROUP (7) EXPERIMENTS.

Taken (+) pooled serum. Complement working at 1 in 60.

0.5 cubic centimetre (+) serum. Euglobulin precipitated by distilled water and acetic acid dissolved in 0.4 cubic centimetre saline = (A).

Untreated (+) serum = (B).

(A) put up against complement without further dilution.

(B) put up against complement in usual 1 in 5 dilution.

Complement dilutions:	1 in 20	1 in 30	1 in 40	1 in 60
(A) Undiluted ..	—	—	—	±
(B) Diluted 1 in 5 ..	—	—	±	+

92 *The Euglobulin Group and the Wassermann Reaction*

Solutions (A) and (B) were put up with antigen against complement in the same strengths as above.

	Complement strengths : 1 in 5			1 in 10			1 in 20		
(A) Undiluted	..	+	..	+	..	+	..	+	
(B) Diluted 1 in 5	-	+	

Interpretation of Results.—In the above experiments the euglobulin group has been used in five times the strength that it normally has in the ordinary 1 in 5 dilution of a serum and even at this strength is apparently less anti-complementary than the diluted serum. The effect of putting up this group in this concentrated strength has given rise to a deviation of twelve hæmolytic doses of complement, whereas the original serum from which it was precipitated only deviated three hæmolytic doses in the usual 1 in 5 dilution.

GROUP (8) EXPERIMENTS.

In Group (7) experiments it was demonstrated that the passage of CO₂ through a solution of serum in distilled water precipitated the main euglobulin group and about half the Wassermann bodies, the other half still remaining in solution. It was also shown that apparently the whole of the euglobulin group and with it all the Wassermann bodies were precipitable by acetic acid after diluting to twenty times with distilled water. Griffith and Scott's experiments tended to show that the passage of CO₂ through a solution of serum in a lower dilution than 1 in 20 of distilled water permitted a larger quantity of Wassermann bodies to be left in the solution. By a combination of these methods it was hoped to precipitate fractionally the euglobulin from a syphilitic serum, separating out a fraction (1) which is common to all sera, and containing only a small amount of the Wassermann substance, from a fraction (2) richer in Wassermann bodies. It was anticipated that difficulties would arise as the Wassermann bodies were apparently closely bound up with the euglobulin group.

Two cubic centimetres of a (++) serum were diluted with distilled water to 1 in 10 dilution and CO₂ bubbled through the solution for a short time until a fair cloud of precipitate was formed.

A subsidiary experiment showed that no fraction of euglobulin could be precipitated from the centrifuged supernatant fluid by acetic acid if the initial passage of CO₂ was unduly prolonged. After the passage of CO₂ with the above precautions a precipitate was centrifuged down which we know from Group (7) experiments comprised the normal euglobulin fraction + a proportion of Wassermann substance.

A sample of the supernatant fluid was put on one side for subsequent testing, and restored to normal tonicity = solution (A). To the main bulk of the supernatant fluid an equal quantity of distilled water was added and a faint hazy precipitate commenced to come down. The addition of 2 per cent acetic acid, 0.025 cubic centimetre per 10 cubic centimetres of solution increased this. The precipitate was then centrifuged down and

was so slight that it appeared as a faint film on the bottom of the centrifuge tubes. Half of the precipitate, i.e., that contained in two centrifuge tubes, was dissolved in 0.3 cubic centimetre saline = (B) and was seen to dissolve more readily than the usual euglobulin, the resulting solution being clear and limpid and not opalescent. The other half was dissolved in 0.5 cubic centimetre of saline = (C). The tonicity of the residual supernatant fluid was now restored by an appropriate addition of salt = solution (D).

We have now four solutions:—

(A) should contain a proportion of euglobulin + a fraction of Wassermann bodies, pseudo-globulins and albumins.

(B) and (C) should contain a little euglobulin and be richer in Wassermann bodies relatively.

(D) is the residual fluid and should contain pseudo-globulins, albumins and little or no Wassermann bodies.

As a preliminary the original serum without dilution was titrated against complement, also the same serum diluted 1 in 5. Solution (B), and solution (C), without further dilution, were also put up.

Complement working in 1 in 60.

		Complement dilutions :					
		1 in 5	1 in 10	1 in 20	1 in 30	1 in 40	1 in 60
(++)	Original serum undiluted	+	+	+	+	+	+
(++)	„ „ 1 in 5	Not put up		—	±	±	+
	Solution (B)	..	..	„ „ „	—	±	+
	„ (C)	..	..	„ „ „	—	±	+

* Very anti-complementary because it was undiluted.

These solutions were now put up in increasing dilution with antigen as for a Wassermann test against 3 M.H.D. of complement = 1 in 20.

		1 in 5	1 in 10	1 in 20	1 in 30	1 in 40	1 in 60	1 in 8	1 in 120
	Dilution of sera :								
	Original serum (++)	+	+	+	+	+	+	—	—
	Solution (A)	..	Not available	+	±	—	—	—	—
	„ (B)	..	+	+	±	—	—	—	—
	„ (D)	..	Not available	—†	—	—	—	—	—

† As this tube failed to show complete hæmolysis until five minutes before the final reading, it can be inferred that (D) still contains a little of the Wassermann bodies.

Interpretation of Results.—The fractional precipitation of the euglobulin group using CO₂ and acetic acid in successive stages seems to have caused some of the Wassermann bodies to be carried over into solution (D). The only way in which the maximum amounts of Wassermann bodies can be precipitated is to bring them down in bulk with the whole of the euglobulin group by the dilution acetic acid method as shown in Group (6) experiments. On looking at the readings given by solutions (B) and (C) it is seen that they are not more anti-complementary than the original diluted serum and much less than the undiluted serum. The titration of (B) in increasing dilutions as a Wassermann test indicates that this fraction contains bodies which are not anti-complementary and have considerable power in deviating complement quite out of proportion to the amount of precipitate when

94 *The Euglobulin Group and the Wassermann Reaction*

compared with the total bulk of precipitable euglobulin. This experiment shows that only a small fraction of the Wassermann bodies can be separated from the normal euglobulin group, and that the primary precipitation of the main bulk of euglobulin by CO_2 makes the later precipitation of the purer Wassermann bodies extremely precarious.

GROUP (9) EXPERIMENTS.

0.5 cubic centimetre of B. and W.'s horse anti-sheep amboceptor was treated with distilled water and acetic acid in the usual way. The precipitated euglobulin was collected and dissolved in saline = solution (A). A sample of supernatant fluid was restored to normal tonicity = solution (B). The main bulk of the supernatant fluid was half saturated with ammonium sulphate, and the precipitate dissolved in saline = solution (C). A sample of this supernatant fluid, after half saturation = (D). The bulk of supernatant fluid was now two-thirds saturated with ammonium sulphate and dissolved in saline = solution (E). The residual fluid = solution (F).

These solutions were put up in increasing dilutions with 1 volume 3 per cent unsensitized cells together with 1 volume of saline. Placed in the water bath for one hour and 3 M.H.D. of complement added. Hæmolysis occurred as follows:—

- (A) = acid euglobulin precipitate +.
- (B) = supernatant fluid of above +.
- (C) = pseudo globulin fraction +.
- (D) = supernatant fluid of above = trace.
- (E) = part of albumen group = trace.
- (F) = nil.

Two quantities of amboceptor were now treated in different ways, viz., by distilled water and acetic acid and by CO_2 and distilled water.

The resulting precipitates were dissolved in saline. The supernatant solutions were restored to normal tonicity by the addition of salt.

Precipitate after acetic acid and distilled water = No. (1).

Supernatant fluid of above = No. (2).

Precipitate after CO_2 = No. (3).

Supernatant fluid of above = No. (4),

The above solutions were titrated up to 1 in 400, and 1 volume of each of these titrations was added to 1 volume of unsensitized cells + 1 volume saline. Placed in water bath for one hour, 1 volume, 3 M.H.D. complement added.

Result.—Within one hour tubes in all groups were hæmolysed. No. (2) tubes being hæmolysed within half an hour.

Interpretation of Results.—It would appear that the hæmolytic substances are contained in both the euglobulin and pseudo-globulin groups, but that the pseudo-globulins contain the greater amount.

GROUP (10) EXPERIMENTS.

In Group (1) experiments it was noted that after precipitation of the euglobulin group from pooled sera by the acid dilution method, it was

possible to place the sera in the order of the intensity of their Wassermann reactions as the (++) seen after treatment were markedly opaque, the (+) less so and the (−) still less opaque.

The subsequent employment of this method has confirmed the observation and the indications are that in the case of untreated or florid cases of syphilis the intensity of the opacity is sufficiently marked to permit of its employment as a confirmatory test of clinical diagnosis in the absence of a laboratory replete with all Wassermann reagents, &c.

An opacity test can be carried out by anybody without any special training. The sole reagents required being distilled water, test tubes, a couple of pipettes or glass rods and two per cent acetic acid. A negative control is essential. The test takes one minute to perform and obtain a result.

It must be clearly understood that it is not suggested that the test can replace a Wassermann reaction but it might serve a useful purpose under the conditions stated above.

Opacity methods being dependent upon observations made by an individual, possibly biased, are fertile subjects for controversy and to substantiate the foregoing statements it might be useful to adduce scientific proof. Pooled sera with both (−) and (++) reactions were treated by the above method. The pseudo-globulins and albumins were poured off from the centrifugalized euglobulins and put on one side. The euglobulins were dissolved in an equal quantity of saline.

Now as the differences in the opacity of the (−) and (++) sera after addition of distilled water and acetic acid must be due to differences in the relative amounts of precipitated euglobulins it was decided to estimate the total nitrogen present in the solutions by Kjeldahl estimations and so calculate out the amount of protein present.

Preliminary Kjeldahl estimations of the pseudo-globulin and albumin fractions in the pooled (++) and (−) seen were made at St. Thomas's Hospital and no marked variations were noted in the results obtained.

Following these examinations estimations of all groups were carried out at the Royal Army Medical College (and results were obtained) as follows:—

In the case of (−) pooled sera—

Pseudo-globulin + albumin fractions	=	5.950	per cent in blood serum
Euglobulin fraction	=	0.875	„ „ „
Total proteins in sera ..	=	6.825	„ „ „

Plimmer's [2] readings for proteins in blood serum after deducting thrombin = 6.85 per cent. The readings from the (++) serum were:—

Pseudo-globulins + albumins ..	=	5.775	per cent in serum
Euglobulins	=	1.050	„ „
Total protein in sera ..	=	6.825	„ „

Comparing the readings obtained from the (++) serum with those from the (−) serum it is seen that the total protein present is the same. The euglobulin group in the (++) sera shows an increase of twenty per cent

over the normal and this increase accounts for the differences in opacity of the original solutions.

SURVEY OF THE FOREGOING EXPERIMENTS.

Friedemann [3] based his theories and work on certain experiments in which he proved to his own satisfaction that the euglobulin group when precipitated by ammonium sulphate was anti-complementary. In the foregoing experiments we have examined the euglobulin group from pooled sera precipitated by acid dilution methods, by CO_2 and by ammonium sulphate.

- The preliminary titrations of this group against complement in Groups (2), (3), (4) experiments should convince anybody that the euglobulin group in our hands does not appear to possess anti-complementary powers. If further and more convincing evidence is required it is only necessary to examine Group (7) experiments in which it is seen that when the euglobulin fraction extracted from 0.5 cubic centimetre sera was dissolved in 0.4 cubic centimetre of saline and put up undiluted against complement it proved to be less anti-complementary than the original serum (in 1 in 5 dilution) from which it was originally extracted.

In the light of these experiments it would seem that Friedemann's theories are untenable. It is true, however, that in Group (4) experiments it is found that the euglobulin obtained by precipitation by ammonium sulphate is more anti-complementary than that obtained by other methods, but still it is not sufficient to account for Friedemann's statements. This increase in anti-complementary powers is attributed to the carrying down of some pseudo-globulins by the ammonium sulphate.

Again, Friedemann's examinations of the different fractions obtained by half and two-third saturation with ammonium sulphate do not afford much proof of the individual properties of the different groups, e.g., his half saturation fraction contains both eu- and pseudo-globulins, his two-third saturation fraction contains eu-, pseudo-globulin and albumin, whereas in our Group (4) experiments it can be seen that the individual groups were fractionally precipitated from the pooled sera by ammonium sulphate, and solution (A) = euglobulin, (B) = pseudo globulin, (C) = albumins, and consequently the titrations against complement give definite information regarding the behaviour of each individual group. The foregoing experiments also prove that the euglobulin fraction precipitated from a syphilitic serum is not more anti-complementary than the euglobulin from a normal serum and that it possesses definite deviating powers when put up with antigens against complement. The theory that the positive reaction in a Wassermann test is a magnification of such anti-complementary powers would also appear to be untenable.

These experiments support in part the statements of Meinicke [4], who believes that the strength of the Wassermann reaction in secondary syphilis is due to the increased quantity and precipitability of the globulins,

CONCLUSIONS.

(1) The Wassermann bodies are solely contained in the euglobulin group and are capable of complete precipitation with this group by dilution acetic acid methods.

(2) The amount of precipitable euglobulin in syphilitic sera varies directly as the strength of the Wassermann reaction. This can be verified by opacity tests, estimation of bulk after centrifugalization and Kjeldhal estimations.

(4) By separation and concentration of the euglobulin group from a (+) serum (= 3 M.H.D. complement deviation), it has been possible to make a solution which with antigen deviates 12 M.H.D. of complement and is not anti-complementary.

(6) Precipitation methods employing ammonium sulphate do not lead to great concentration of the Wassermann bodies but result in marked anti-complementariness with the higher saturations.

(8) In malaria, under certain conditions, bodies may appear in serum which belong to the globulin group and react in the same way as the Wassermann bodies.

In conclusion I wish to acknowledge my indebtedness to Captain T. E. Osmond, R.A.M.C.(Ret.), pathologist to the Venereal Clinic at St. Thomas's Hospital, for supplying me with standard reagents, tested sera, and for his valuable advice which has been at my service throughout; to Dr. de Wesselaw, Chemical Pathologist to St. Thomas's Hospital for the preliminary Kjeldahl tests; to Major Elliott, Instructor of Chemistry at the Royal Army Medical College for the final estimations which are included in detail in Group (X) experiments.

[1] Reports on Public Health and Medical Subjects, No. 1, p. 71.
 [2] "Plimmer's Textbook on Organic and Biochemical Chemistry," p. 442.
 [3] Reports on Public Health and Medical Subjects, No. 1, pp. 154-160.
 [4] " " " " " " p. 188.

THE ORIGINAL SACHS-GEORGI REACTION IN THE TROPICS AS AN INDICATION FOR DIAGNOSIS AND TREATMENT OF SYPHILIS.

By W. LESLIE WEBB.

Medical Officer, Uganda.

I.—THE WASSERMANN REACTION AND THE SACHS-GEORGI REACTION.

DURING 1921 over two thousand serums were tested by the Sachs-Georgi reaction at the Venereal Diseases hospital at Mulago in Uganda. Owing to the conditions under which the work was carried out, it was only possible to do the Wassermann reaction as control on less than half these serums.

The Technique of the Sachs-Georgi Reaction.—The Sachs-Georgi antigen was prepared as follows: An alcoholic extract of bullock's heart was made, using one gramme of heart muscle to each 5 cubic centimetres of absolute alcohol; 1 cubic centimetre of this extract was mixed with 2 cubic centimetres of absolute alcohol, and to the mixture was added 0.135 cubic centimetre of a one per cent solution of cholesterin in absolute alcohol; 1 cubic centimetre of this mixture added to 5 cubic centimetres of 0.85 per cent saline made the antigen ready for use in the test. In order to produce as clear a solution as possible, the antigen mixture was blown from a pipette into the saline; usually the saline is added to the antigen mixture, but this produced a somewhat turbid fluid, which I found by experience did not give as good results as the clearer mixture. The serum of the patient was inactivated at 56° for half an hour; 0.1 cubic centimetre was then pipetted into a small test tube, $\frac{1}{2}$ inch in diameter, and to it was added one cubic centimetre of 0.85 per cent saline, giving a dilution of 1 in 11, as compared with 1 in 10 dilution commonly used. This was only done as a time-saving device necessitated by the small equipment I had at my disposal at the time. To the tube was now added $\frac{1}{2}$ cubic centimetre of the antigen emulsion. The mixture was incubated at 37° C. for eighteen to twenty hours, and then left at room temperature a further twenty-four hours before being read.

The reading was done against a black background, and a 15 diameter hand lens used for the tubes showing no naked-eye flocculation. In a strong positive reaction, a massive white precipitate lay at the bottom of clear fluid. A less strong positive reaction showed flocculation clearly to the naked eye. In a weak positive reaction the flocculation could only be seen with the lens. A doubtful reaction showed a mottling of the fluid when seen through the lens, but no clear flocculation. A negative reaction showed a perfectly homogeneous fluid through the lens. Generally each serum was tested with two or more antigens, but in 90 per cent of the

reactions the original Sachs-Georgi antigen was used as one, and the readings taken were from this antigen, whenever possible. Other antigens used were one prepared from the human heart, Burroughs and Wellcome guinea-pig heart and cholesterin antigen, and Bordet-Ruelen's antigen. Reference will be made to these later.

The Technique of the Wassermann Reaction.—The method of Macintosh and Fildes was followed faithfully throughout with the important exception that the Sachs-Georgi antigen was used instead of the human heart antigen. This was done, not because it was considered an improvement, but that the attitude of the natives towards post-mortem interference and their interest in, and the mystification of, laboratory work, made it particularly difficult for me to obtain human hearts and to have done so might have jeopardized the popularity of the hospital. At the only time I had such an antigen, the Wassermann reaction was in abeyance as the hæmolytic serum had succumbed to the climate.

TABLE I.—SHOWS THE RESULTS OF 2,508 SERUMS TESTED BY THE SACHS-GEORGI REACTIONS ALONE.

	Total serums	Positive serums	Doubtful serums	Negative serums	Per cent positive	Per cent doubtful	Per cent Negative
Primary syphilis ..	222	127	44	51	57	20	23
Secondary syphilis ..	1,238	878	188	172	71	15	14
Tertiary syphilis ..	331	244	33	54	74	10	16
Latent syphilis ..	259	160	43	56	62	16	22
Negative controls ..	34	0	4	30	..	..	..
Yaws ..	36	24	4	8	..	..	..
General population..	388	181	65	142	46·5	17	36·5
Totals and average percentages	2,508	1,614	381	513	64·3	15·3	20·4

TABLE II.—GIVES THE RESULT OF 1,147 SERUMS TESTED BOTH BY THE SACHS-GEORGI REACTION AND THE WASSERMANN REACTION.

	Total serums	Positive serums		Doubtful serums		Negative serums		Per cent positive		Per cent doubtful		Per cent negative		Serums				Per cent			
		S.G.	W.R.	S.G.	W.R.	S.G.	W.R.	S.G.	W.R.	S.G.	W.R.	S.G.	W.R.	S.G. and W.R. agree	W.R. positive S.G. negative	S.G. positive W.R. negative	Agree	W.R. positive S.G. negative	S.G. positive W.R. negative		
Primary syphilis..	116	65	77	25	12	26	27	56	66	22	11	22	23	84	22	10	72	19	9		
Secondary syphilis	517	361	444	83	39	73	34	70	86	16	7½	14	6½	381	111	25	74	21	5		
Tertiary syphilis..	148	105	126	19	9	24	13	70	85	14	6	16	9	113	27	8	76	18	6		
Latent syphilis ..	124	76	99	25	14	23	11	61	80	20	11	19	9	86	30	8	69	24	7		
Negative controls	9	0	0	0	2	9	7	..	..	..	..	..	..	9	0	0	—	—	—
Yaws	17	12	16	1	0	4	1	..	..	..	..	..	..	11	5	1	—	—	—
General population	216	101	100	40	45	75	71	46½	46	19	20½	34½	33½	163	26	27	75	12½	12½		
Totals and average percentages	1,147	720	862	193	121	234	164	63	75	17	11	20	14	847	221	79	74	19	7		

These two tables show that the serums on which both reactions were done correspond very closely in their Sachs-Georgi results, with the total serums tested by this reaction, and usually further reference will not be made to any serums on which only one of the tests was done,

It should be explained that in the second table, a doubtful reaction and a negative reaction have been regarded as agreeing, but a doubtful reaction and a weak positive reaction have been taken as disagreeing.

A more detailed consideration of these results under their different headings is made.

(1) *Primary Syphilis.*

Of the 116 serums tested, 87 were from cases who showed active signs of syphilis, treated and untreated; 29 had lost active signs under treatment. Although the numbers do not justify expression in percentages, I propose to do this for comparison with the results in secondary syphilis.

TABLE III.—SYPHILIS 1.

	Total serums	Positive serums		Doubtful serums		Negative serums		Per cent positive		Per cent doubtful		Per cent negative		Serums			Per cent		
		S.-G.	W.R.	S.-G.	W.R.	S.-G.	W.R.	S.-G.	W.R.	S.-G.	W.R.	S.-G.	W.R.	Agree	W. positive S.-G. negative	W. negative S.-G. positive	Agree	W. positive S.-G. negative	W. negative S.-G. positive
With active signs	87	55	60	20	10	12	17	63	69	23	11	14	20	68	12	7	78	14	8
No active signs	29	10	17	5	2	14	10	34	58	18	8	48	34	16	10	3	55	34	11
Total ..	116	65	77	25	12	26	27	56	66	22	11	22	23	84	22	10	72	19	9

TABLE IV.—SYPHILIS 2.

	Total serums	Positive serums		Doubtful serums		Negative serums		Per cent positive		Per cent doubtful		Per cent negative		Serums			Per cent		
		S.-G.	W.R.	S.-G.	W.R.	S.-G.	W.R.	S.-G.	W.R.	S.-G.	W.R.	S.-G.	W.R.	Agree	W. positive S.-G. negative	W. negative S.-G. positive	Agree	W. positive S.-G. negative	W. negative S.-G. positive
With active signs	349	263	318	42	16	44	15	75	91	12½	4½	12½	4½	264	70	15	75	20	5
No active signs	168	98	126	41	23	29	19	58	75	24	14	18	11	117	41	10	70	24	6
Totals ..	517	361	444	83	39	73	34	70	86	16	7½	14	6½	381	111	25	74	21	5

(2) *Secondary Syphilis.*

Three hundred and forty-nine of the cases of secondary syphilis, with and without treatment, showed active signs of disease. One hundred and sixty-eight had lost active signs under treatment.

Tables III and IV appear to show that the effect of treatment as indicated by the loss of active signs of disease, influences the Sachs-Georgi reaction more than the Wassermann reaction. All the figures so far were obtained from laboratory records. To confirm this impression a table was compiled from the case record sheets. In it, serums tested with either or both reactions are considered. The difference in the total number of serums tested in this table, and in the previous tables, is explained by the fact that a certain number of the earlier reactions were not recorded in the laboratory lists.

TABLE V.—SYPHILIS 2.

	Sachs-Georgi reaction				Wassermann reaction				Percentages					
	Total serums	Positive serums	Doubtful serums	Negative serums	Total serums	Positive serums	Doubtful serums	Negative serums	Positive serums		Doubtful serums		Negative serums	
									S.G.	W.R.	S.G.	W.R.	S.G.	W.R.
Cases under treatment from 0 to 3 weeks	646	561	47	38	307	292	10	5	87	95	7	3	6	2
Cases under treatment from 3 to 6 weeks	209	155	29	25	114	99	7	8	74	87	14	6½	12	6½
Cases under treatment from 6 to 24 weeks	312	178	53	81	211	156	14	41	57	74	17	7½	26	19½
Rest from treatment of 3 to 30 weeks														
Cases seen after rest ..	108	66	14	28	68	55	5	8	61	81	13	8	26	11
Cases seen middle of second course	27	16	7	4	12	11	1	0	—	—	—	—	—	—
Cases seen at end of second course	5	2	1	2	2	1	1	0	—	—	—	—	—	—
Total	1,307	978	151	178	714	614	38	62	—	—	—	—	—	—

This table confirms the observation that treatment has a relatively greater effect on the Sachs-Georgi reaction of reducing the number of positive serums than it has on the Wassermann reaction. Perhaps this is best shown by reduced copies of some of the actual case sheets.

Over a hundred such examples could be given. The Sachs-Georgi reaction did not behave invariably thus nor even in the majority of cases, but to my mind it did display a distinct tendency to give a negative reaction as the result of treatment alone, and not as an indication of the course of the disease. The majority of cases which become negative to the Sachs-Georgi reaction as a result of a course of treatment, manifestly insufficient to cure them of syphilis, gave a positive Sachs-Georgi reaction again when treatment had been withheld for some weeks. This was not

102 *The Original Sachs-Georgi Reaction in the Tropics*

invariably so, and in some cases the Sachs-Georgi reaction remained or became negative even though the patient returned showing signs of an active relapse, as in Case 31 shown below.

NOTE.—A strong positive reaction in both tests is shown thus + + +.
A moderate reaction as + +. A weak positive reaction by + :
A doubtful reaction ± and a negative reaction —.

Case 10. *Secondary Syphilis.*

1st week of treatment	..	S.G. +		
3rd " "	..	S.G. + +		
6th " "	..	S.G. —		
9th " "	..	S.G. —		
12th " "	..	S.G. —	..	Lost active signs.

Case 31. *Secondary Syphilis.*

1st week of treatment	..	S.G. + + +	W.R. + + +	
3rd " "	..	S.G. + + +	W.R. + + +	.. Lost active signs.
5th " "	..			.. Ten weeks' rest from treatment.
6th " "	..	S.G. —	W.R. + + +	.. Relapse.
8th " "	..			.. Lost active signs.
10th " "	..	S.G. —		

Case 42. *Secondary Syphilis.*

1st week of treatment	..	S.G. + +		
5th " "	..	S.G. ±	W.R. + + +	.. Lost active signs.
10th " "	..	S.G. —	W.R. + + +	.. Relapse.
18th " "	..	S.G. —		.. Lost active signs.

Case 217. *Secondary Syphilis.*

1st week of treatment	..	S.G. + + +		
4th " "	..	S.G. + + +		
8th " "	..	S.G. +		
11th " "	..	S.G. ±		
15th " "	..	S.G. —		.. Lost active signs.
16th " "	..			.. Four months' rest from treatment.
17th " "	..	S.G. + + +	W.R. + + +	.. Relapse.

Case 302. *Primary Syphilis.*

1st week of treatment	..	S.G. —	W.R. ±	
3rd " "	..	S.G. + +	W.R. + + +	
9th " "	..			.. Lost active signs.
10th " "	..	S.G. —	W.R. + + +	
11th " "	..			.. Six weeks' rest from treatment.
12th " "	..	S.G. + +		.. No active signs.

Case 507. *Secondary Syphilis.*

1st week of treatment	..	S.G. + + +		
5th " "	..	S.G. ±		
9th " "	..	S.G. ±		
13th " "	..	S.G. —	W.R. + + +	.. Lost active signs.
14th " "	..	S.G. + + +	W.R. + + +	.. Two months' rest from treatment.

(3) *Tertiary Syphilis.*

The figures in Table II include all cases of tertiary syphilis, treated and untreated, with signs and without signs, congenital and acquired. This accounts for the comparatively low percentage of positive results in both the Wassermann and the Sachs-Georgi reactions.

(4) Latent Syphilis.

These serums were taken from pregnant native women, the majority of whom gave a history of acquired or congenital syphilis and many of whom gave a history of repeated miscarriages. The personal histories obtained from natives are not reliable and some cases who had never had syphilis may have been included. The inclusion of non-syphilitic cases is somewhat unlikely, when the prevalence of the disease amongst the Baganda is considered.

(5) Negative Controls.

The two controls that gave a doubtful result with the Wassermann reaction were both taken from natives. It is practically impossible to be certain of obtaining a known negative serum from any native, and as the number of Europeans willing to be bled regularly is very limited and at times non-existent, the obtaining of reliable negative controls remains, and is likely to remain, a great difficulty.

(6) Yaws.

Yaws appears to react in precisely the same way as secondary syphilis.

(7) General Population.

The greater number of these bloods were kindly sent me from the C.M.S. Hospital at Namirembe, Kampala, and were taken from the general in-patient population at the hospital. It is generally acknowledged by the medical faculty here that 75 per cent of the native population is tainted with congenital or acquired syphilis. This group of serums is interesting in that it is the only group in which the two reactions meet on terms of equality and more or less agree.

CONCLUSIONS.

A comparison between the two tests as performed in the laboratory at Mulago leads to the following conclusions :—

(1) That the Sachs-Georgi reaction gives a considerably lower percentage of positive results in all cases of syphilis, including untreated cases, than the Wassermann reaction.

(2) That the two reactions agree in only 74 per cent of cases, and that of the remaining 26 per cent of cases 19 per cent are positive to the Wassermann reaction and negative to the Sachs-Georgi reaction, and 7 per cent are positive to the Sachs-Georgi reaction and negative to the Wassermann reaction.

(3) That the Sachs-Georgi reaction shows a very decided tendency to become negative as treatment progresses irrespective of the clinical condition of the patient and of the probability of his cure.

(4) That consequently the Sachs-Georgi test is not a reliable indication of cure in cases of primary and secondary syphilis.

(5) That a positive Sachs-Georgi reaction in cases of syphilis or suspected syphilis would appear to be as valuable as a positive Wassermann reaction, as an indication for commencement or continuation of treatment, but that a negative Sachs-Georgi reaction is of very little value.

(6) The Sachs-Georgi reaction is more difficult to read than the Wassermann reaction, which leads to a high percentage of doubtful readings. In most of the results given the combined percentage of positive and doubtful Sachs-Georgi reactions correspond very closely to the percentage of positive Wassermann reactions.

(7) That the Sachs-Georgi reaction appears to be as specific for syphilis as is the Wassermann reaction.

(8) That in spite of the obvious inferiority of the Sachs-Georgi reaction to the Wassermann reaction, it has a very useful application indeed in those tropical countries where it is difficult to perform the Wassermann reaction satisfactorily, and I strongly recommend its adoption as a routine diagnostic agent in these circumstances.

II.—EXPERIMENTS IN THE SACHS-GEORGI REACTION.

During the time that Sachs-Georgi reaction was being used as a routine test in this hospital a certain number of experimental tests were made with different antigens, temperatures, etc. The criterion of efficiency which has been taken is the proportion of serums of secondary syphilitics with active signs which gives a positive reaction, always provided that the controls behaved normally. This method may not give a strictly accurate picture, but it has the advantage of making it possible to express the results in a reasonably short space.

(a) *Sachs-Georgi Antigen v. Bordet-Ruelen's Antigen.*—The Sachs-Georgi antigen was prepared in the way described in Part I of this paper. The Bordet-Ruelen's antigen was prepared as follows: 100 grammes of coarsely minced bullock's heart was placed in a flask with 125 cubic centimetres of absolute alcohol and the mixture shaken. It was allowed to stand at room temperature for four days, and then filtered. The residue was spread on a plate and dried at 37°C. for twenty-four hours. When dry it was treated in a flask with 200 cubic centimetres acetone for ten days. It was then filtered, the residue dried, and treated with fresh acetone for one day. It was again filtered and the residue, after being dried in the incubator, was put in a flask with 200 cubic centimetres of absolute alcohol and kept for ten days at room temperature. The filtered fluid was the antigen. For use, 1 cubic centimetre of this fluid was mixed with 2 cubic centimetres of absolute alcohol, and to the mixture 0.135 cubic centimetre of one per cent cholesterin in absolute alcohol was added. One cubic centimetre of this mixture was blown from a pipette into five cubic centimetres of 0.85 per cent saline, forming a nearly colourless and clear solution. This solution was the antigen used in the test, and the test was performed in the same way as described in Part I of this paper.

The agreements and disagreements of these two methods of performing the Sachs-Georgi reaction and of the Wassermann reaction are shown by the following tables :—

(1) SACHS-GEORGI REACTION S.G. ANTIGEN. (2) SACHS-GEORGI REACTION B.R. ANTIGEN.

	Total serums	Serums agree	S.-G. antigen positive. B.R. antigen negative	B.R. antigen positive. S.-G. antigen negative	Percentages		
					Agree	S.-G. antigen positive. B.R. antigen negative	B.R. antigen positive. S.-G. antigen negative
All cases	1,309	1,072	90	147	82	7	11
Secondary syphilis with signs	383	323	19	41	84	5	11

(1) SACHS-GEORGI ANTIGEN. (2) WASSERMANN REACTION.

	Total serums	Serums agree	S.-G. positive. W.R. negative	S.-G. negative. W.R. positive	Percentages		
					Agree	S.-G. positive. W.R. negative	S.-G. negative. W.R. positive
All cases	820	592	39	189	72	5	23
Secondary syphilis with signs	259	193	4	62	74½	1½	24

(1) SACHS-GEORGI REACTION, BORDET RUELEN'S ANTIGEN. (2) WASSERMANN REACTION.

	Total serums	Serums agree	B.R. positive. W.R. negative	B.R. negative W.R. positive	Percentages		
					Agree	B.R. positive W.R. negative	B.R. negative W.R. positive
All cases	829	667	33	129	80	4	16
Secondary syphilis with signs	258	218	4	36	84	2	14

The following table gives the results for the three reactions in cases of secondary syphilis showing active signs of disease.

—	Total serums	Positive serums	Doubtful serums	Negative serums	Percentages		
					Positive	Doubtful	Negative
Sachs-Georgi—							
S.-G. antigen ..	383	283	44	56	74	11	15
B.R. „ ..	383	305	29	49	80	7	13
Sachs-Georgi—							
S.-G. antigen ..	259	185	36	38	71	14	15
Wassermann re- action	259	243	9	7	94	3½	2½
Sachs-Georgi—							
B.R. antigen ..	258	209	19	30	81	7	12
Wassermann re- action	258	242	8	8	94	3	3

From these tables it would appear that the results of the Sachs-Georgi reaction approximate much more closely to the Wassermann reaction when Bordet Ruelen's antigen is used than when the Sachs-Georgi antigen is used. The Bordet Ruelen's antigen with which these reactions were carried out had been in use and kept at room temperature for six months before it showed signs of losing power, showing a great improvement in keeping power over the Sachs-Georgi antigen, which only retains its activity for less than half this period when kept under the same conditions.

(b) Two hundred and forty serums were tested with the following antigens:—

(1) Sachs-Georgi antigen as always used.

(2) Bordet Ruelen's antigen prepared as follows:—

Antigen one cubic centimetre, one per cent cholesterin, 0.05 cubic centimetre, one part antigen mixture in thirty-five parts of 0.85 per cent saline. The saline was added drop by drop to produce a turbid emulsion. Sixty-seven of these serums were taken from cases of acute secondary syphilis and gave the following results:—

	Positive	Doubtful	Negative	Total
Antigen 1 ..	52	9	6	67
Antigen 2 ..	52	2	7	67

For three weeks in succession the second antigen then gave positive results for all serums over 300 in all, and further experiments with this antigen were abandoned.

(c) *Opalescent versus Turbid Antigens.*—Two hundred and sixteen serums were tested with the Sachs-Georgi antigen in opalescent and turbid emulsions. Ninety-eight of these serums were from cases of acute secondary syphilis and gave the following results:—

	Positive	Doubtful	Negative	Total
Opalescent antigens ..	83	11	4	98
Turbid antigen ..	74	7	17	98

(d) *Reading after eighteen hours and forty-two hours.*—Over two hundred serums were read after eighteen hours' incubation at 37°C, and again after

having been put aside at room temperature for a further twenty-four hours. Ninety-six of these serums were from active secondary syphilitics:—

	Positive		Doubtful		Negative		Total
(1) Reading at eighteen hours at 37° C.	67	..	19	..	10	..	96
(2) Reading at eighteen hours at 37° C. + twenty-four hours at room temperature	82	..	10	..	4	..	96

In each case the negative controls remained negative.

(e) Eight serums were tested by the Sachs-Georgi reaction using Bordet Ruelen's antigen, with and without the addition of cholesterin. The results were identical.

(f) Macintosh and Fildes' human heart antigen was tried on a few serums, but was not satisfactory.

(g) Burroughs and Wellcome's guinea-pig heart and cholesterin antigen was used on about twenty serums, and appeared to react quite satisfactorily.

(h) The acetone soluble elements of bullock's heart and the alcohol soluble fraction of this were tried as antigens on over 100 serums. In every case including the negative controls they gave a positive reaction.

(i) Twenty serums, after the diluted serums and the antigen were mixed, were put in the water bath at 55° C. for two hours. The readings were negative throughout after a further twenty-four hours at room temperature.

(j) Over 100 serums were incubated at 43° C. for eighteen hours and read after a further twenty-four hours at room temperature. The readings did not differ from those incubated at 37° C. for eighteen hours, but the reaction was, on the whole, cleaner cut.

CONCLUSIONS.

(1) The most effective antigen we have used at this laboratory has been Bordet Ruelen's antigen. The emulsion is made as follows:—

Bordet Ruelen's antigen	..	..	..	1 cubic centimetre
Absolute alcohol	..	..	..	2 " "
1 per cent cholesterin in absolute alcohol	..	0.135	..	" "

One cubic centimetre of this mixture added to five cubic centimetres of 0.85 per cent. saline to form an opalescent emulsion.

(2) An opalescent antigen emulsion is more effective than a turbid emulsion.

The clearest emulsion is obtained by blowing the antigen mixture from a pipette into the right amount of saline as quickly as possible.

(3) Better results are obtained with all the antigens usually used by reading the reaction after eighteen to twenty-four hours' incubation and twenty to twenty-four hours' at room temperature, than by reading directly after eighteen to twenty-four hours' incubation.

(4) Incubation at 43° C. gives cleaner-cut results than incubation at 37° C.

(5) Where the Sachs-Georgi reaction is being used alone, and is not corrected and controlled by the Wassermann reaction, more reliable results are obtained by using two or three different antigens for each serum.

(6) I would again point out that in my experience the Sachs-Georgi reaction, using both the Sachs-Georgi antigen and the Bordet Ruelen's antigen in each case, and in the manner mentioned above, is of the utmost value as an aid in the diagnosis of doubtful cases of syphilis, and to a less extent as an indication of cure or for further treatment, and could be usefully employed in all countries where, from one reason or another, the performance of the Wassermann reaction is impracticable. Its technique is so simple and its requirements so few, that it is hard to imagine any place where this reaction could not be carried out easily. Its adoption as a routine in such countries would undoubtedly lead to the more accurate diagnosis and treatment of syphilis.

I wish to record my thanks to Major Keene, R.A.M.C., Specialist Officer Venereal Diseases, Uganda, for the help he has given me in supervising this paper; to Mr. E. S. Smout for his assistance in carrying out the reactions; and to Major Wiggins, Principal Medical Officer, Uganda, for permission to publish this article.

THE CATARRHAL PHASE.

BY MAJOR H. GALL.

Royal Army Medical Corps.

THIS article is written to support the opinion that the past fifteen years have marked a phase of specifically diminished resistance to many air-born infective processes. The qualification *specific* is the essence of this proposition, for it can hardly be questioned that air-borne disease has been out of hand of late, but this might well be the result of general causes rather than chiefly of a specific cause.

At a recent examination in clinical medicine held at the Royal Army Medical College the following case was shown: A robustly made man of about 30 years of age, whose life had been suddenly and completely ruined by an attack of broncho-pneumonia in 1918. A very accurate account of this man's condition is immaterial and it is enough for the purpose to say that from the date of his illness in 1918, to the latter part of 1920, he had suffered more or less continuously from chronic bronchitis, or perhaps better from chronic broncho-pneumonia, with frequent exacerbations. This condition completely crippled him. He presented the grossest physical signs of bronchitis affecting tubes of all sizes, both lungs being choke-full of râles and rhonchi of every description. He coughed up a large quantity of sputum for which his bronchitis seemed easily accountable without necessarily invoking bronchiectasis or buried empyema, etc., to explain it. He had no fever, his tongue was clean and moist. He professed himself quite well "in himself" and looked it. The complete lack of constitutional signs contrasted forcibly with the gross and distressing degree of local disease and this paradoxical contrast seemed to lend him almost the appearance of having been bewitched.

Such a case is a severe but otherwise typical example of a latter day tendency in infective respiratory disease, the results of which must frequently present themselves to all who practise as physicians. There have invariably been two or three such cases at the Queen Alexandra Hospital of late. It would not be of particular interest to quote this case except that it conveniently introduces some remarks on the subject it exemplifies and related matters. I think also that the case was possibly given in an examination as an example of a type of failure in resolution which is gaining in importance.

While in charge of two medical wards at the Queen Alexandra Hospital during some nine weeks in the warm months of August to October, 1921, there were admitted to those wards some twenty cases of intractable bronchitis, the average age of these twenty patients being about 21 years. When I say "intractable" I do not mean that these men and boys

were all so bad as to preclude further military service, though some have been invalidated. I simply mean that these cases all presented a chronic element of failure of resolution. The majority of these even when "well" usually carry about with them some physical signs of bronchitis. The majority of them admit that they have been liable to bronchitis since boyhood. The physical standard of this small group was quite up to the average.

In this twenty I have not included some other cases of bronchitis with physical signs in the lungs, but in whom the disease was not thus chronically established, which were admitted to the same wards, during the same period, nor other similar "non-resolution" cases which have been admitted more recently since the weather became colder. During the period, August to October, 1921, moreover, we had in the Queen Alexandra Hospital a somewhat troublesome outbreak of bronchitis and broncho-pneumonia in a surgical ward of which I was temporarily in charge. During the past winter, again, the hospitals of the London area were being crowded out with influenzal illnesses, incidents in a world-wide pandemic. At the Queen Alexandra Hospital therefore, and for a matter of that at many another, infective respiratory illnesses are very prominent and puzzling.

These newly prevalent types of bronchitis and broncho-pneumonia, which fasten on the young and healthy, and never again properly leave them, are distinctly a feature of the times. They have suddenly greatly increased in number in the present century, excluding, I believe, however, the first few (about five) years of it.

It is interesting to consider the past ten or fifteen years in a little more detail from this point of view. About fifteen years ago the very striking latter-day dominance of the catarrhs suddenly established itself after having spared the first few years of the century. This began in 1906, or to anticipate for convenience, ? in the latter part of 1905. About these post 1905 catarrhs there rapidly grew up a practically new department in bacteriology, viz., the bacteriology of the common cold, its vaccine treatment, and so on.

If you will look up the index of the *Lancet* or the *British Medical Journal*, you will simply never see common cold or naso-pharyngeal catarrh mentioned before 1906. Suddenly from that date, however, you will begin to find references to articles, and even to leading articles on the subject of the common cold and its bacteriology.

Abruptly, from about that time also, the daily Press began to notice strange outbreaks of influenzal illnesses and colds, often marked by unusually profuse coryza, and to give accounts of all kinds of new-seeming catarrhal illnesses remarkable enough to interest the general public who, moreover, began frequently to have fairly good cause to take some interest in such matters.

Nothing of the kind had ever been mentioned in this way in the Press

within memory. Epidemics of influenza had occasionally been mentioned when that disease occurred, but these year-in year-out catarrhal affections were something new, and the whole thing marked a truly new phase and one of very sudden origin indeed.

From 1906 further began the period of the "mystery" epidemics of various kinds, the description of which has been so noticeable in the daily Press of late years. The latest examples occupied the London Press during the past winter as just mentioned. "The London fever hospitals were crowded out and cases were being turned away." The papers referred to this outbreak as the "mystery fever." Quite apart from the question of the justification for the description in this particular case it is characteristic of the times that epidemics frequently arise which often puzzle those who have to deal with them; moreover, this applies to the case of the domestic animals as well as to that of mankind.

To come to the present time, the naso-pharyngeal catarrhs have it all their own way with us. There seems to be some defect in our natural resistance to them. Half the population is subject to recurring catarrhs at all times and seasons of the year. The illustrated daily papers have for a long time past made copy out of photographs of school children doing special nasal douche practice, and descriptions of anti-catarrhal measures of various kinds. The thing is the talk of all, though we have got accustomed to it and do not give the attention to it which we might. Notwithstanding the fact that the more severe types of this naso-pharyngeal catarrh cause a lot of disability.

A short time ago, on November 11, 1921, to be exact, the principal page of a London illustrated daily paper was chiefly occupied with a strongly worded article on the subject of the common cold, in which it was seriously insisted that the disease should be made compulsorily notifiable and the cases isolated by being kept from work. I take an interest in the attitude of the daily press to these matters, and though I sympathize with those who take them seriously I thought for a moment that this particular article must be a hoax. It was clearly however seriously meant. One may not feel inclined to take this sort of thing very seriously, but nevertheless there was absolutely nothing, say, in our student days of fifteen or more years ago, that could have provided "copy" of this sort to even the most enterprising and sensational journalist, whereas to-day the journalist has every justification for emphasizing the question. The most trivial minor ailment has suddenly evolved into a regular pest.

It is an easy step from all this to a stir in the more serious respiratory infections. The war years gave the new tendency a great opportunity which it availed itself of readily. The manner in which the respiratory infections behaved in many training camps in this country was I believe somewhat unexpected. The official account however of how infective disease, respiratory and other, ravaged and paralysed several of the vast

American training camps in the last quarter of 1917 admits that this "makes disheartening reading."

It is clear on reading the account that those responsible felt that there was an element in the case for which there was no precedent, and this not so much because some of the admission rates were very high as because resistance to infectious disease seemed in a curious state. The whole thing apparently puzzled those concerned in circumstances in which a high admission rate for infectious disease of normal behaviour would not have been surprising.

From the clinical standpoint there has been much in the post 1905 phase which points to some specific defect in the immunizing powers of the body, extravagant though such a premise may seem. According to this idea the fault lies in the weakness of the defence rather than in the strength of the attack. If it were the strength of the attack which had gained we should have to admit this accession of virulence to many of the common infective agents. This latter possibility is presumably much more difficult to account for than the former, for a weakening in the bodily resistance provides the situation with a workable common denominator.

A specific defect in the protective power of the body against bacterial invasion such as that suggested might be compensated for fairly well under normal conditions of life but proclaims itself under conditions of military concentration and national hardships.

That some influence of this kind was in existence before the war years is the essence of this thesis. Great concentrations are held capable of pretty well anything in this line and no doubt rightly so. If the phenomena in question only dated from 1914, they could be passed as not very surprising or important.

In 1906 there suddenly appears in the Annual Report on the Health of the Army a note of uneasiness in the prevalence of certain minor ailments. For instance, up to 1906 tonsillitis is never mentioned in the annual reports except to give without comment the bare figure showing its admission rates.

From 1906 to practically 1914 however, much attention is suddenly directed to the trouble and difficulty resulting from the endemicity of tonsillitis in various commands and stations.

Energetic administrative measures did not, as time went on, achieve results which were to be expected. This sudden solicitude on the subject of tonsillitis from 1906 onwards corresponds very well with the sudden new and wide-world interest in the behaviour of the common cold in the medical and other journals dating from that year which has already been mentioned.

You may consider what follows merely a coincidence, but there occurred

¹ The Annual Report of the Surgeon-General, United States, 1917, p, 237.

in 1906, strictly to time according to this hypothesis, a clinically somewhat remarkable outbreak of non-diphtherial tonsillitis in the Duke of York's School at Dover. It is described at length in the 1906 Report and subsequent reports, for it lingered intractably in true post 1905 fashion.

It is noteworthy that the post 1905 period has been punctuated with very fatal outbreaks of septic tonsillitis in various parts of the world which have been new, clinically speaking, to those who have encountered them. For an example of this may be quoted the severe and fatal outbreaks of septic tonsillitis in various American cities which were occurring shortly before America declared war. I have seen a very fatal small outbreak in an Indian hill station, and generally such outbreaks have become not uncommon.

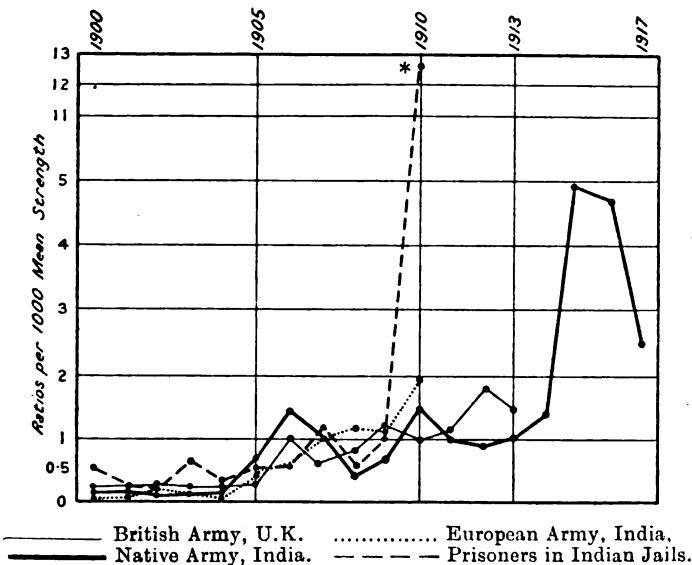


CHART 1.

Admissions to Hospital for catarrhal nasal conditions.†

* Figures not available after 1910 for Indian prisoners.

† i.e., the diagnoses nasal catarrh, rhinitis and coryza.

A somewhat curious point regarding the comments just mentioned on tonsillitis in the Annual Reports after 1905 is the fact that during the post 1905 period the admissions for tonsillitis in the British Army declined. Notwithstanding this, however, tonsillitis succeeded in making itself more obtrusive. I know, however, that among the civil population about that time throat complaints increased noticeably and it was only owing to the keen measures in preventive medicine then in vogue in the Army that the adverse ætiological influence in question was unable to operate fully until later, as we shall see. No one could deny that at the present day tonsillitis

even in the Army is worse both in quantity and severity, for at the present day this new influence persists and has defeated preventive measures in many directions, a fact which is reflected in recent admission ratios for the Services of all countries. The new catarrhal ætiology which suddenly made good in 1905 found itself opposed to the momentum of a tide of amelioration in preventable disease. None the less I believe that it made its presence felt in some measure practically from the first. Thus the figures for the upper respiratory catarrhs all over the world show anything

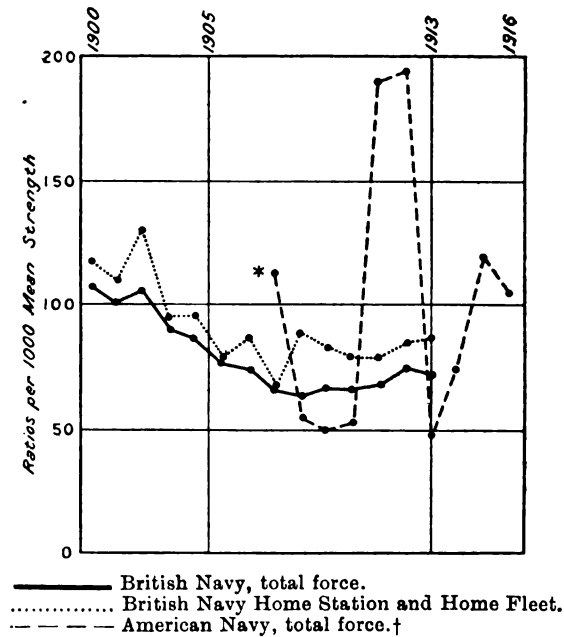


CHART 2.

Total respiratory diseases.

* Earliest year for which figures are available.

† Admissions and readmissions. The figures include influenza and the diseases included in group xiv of the current nomenclature.

but amelioration in the post 1905 period. Some curves relating to these conditions are shown in Chart 1.¹ Records of these are scanty however. The effect on the major respiratory illnesses followed almost as rapidly in the general population but not to the same extent in the Army and the change here at first was perhaps one of quality rather than of quantity. Of this we naturally find nothing in statistical figures. If we turn to British naval figures, however, we see the operation of this new post 1905 influence on the curve for total respiratory diseases. Chart 2. Here there is no

¹ No figures quoted in this article include any Expeditionary Force cases of the late war.

amelioration after about 1905. Note that the curve does not flatten out gradually but is abruptly angulated after 1905. Thereafter it tends to drift upwards as respiratory diseases tend to escape from control. For the American Navy figures for respiratory diseases seem only available from 1907. The bearing of these figures on the contention that there was marked activity in respiratory illnesses before the recent war seems obvious. Chart 2. I think it possible that naval figures may be a more sensitive index to the general health of a country than are military ones.

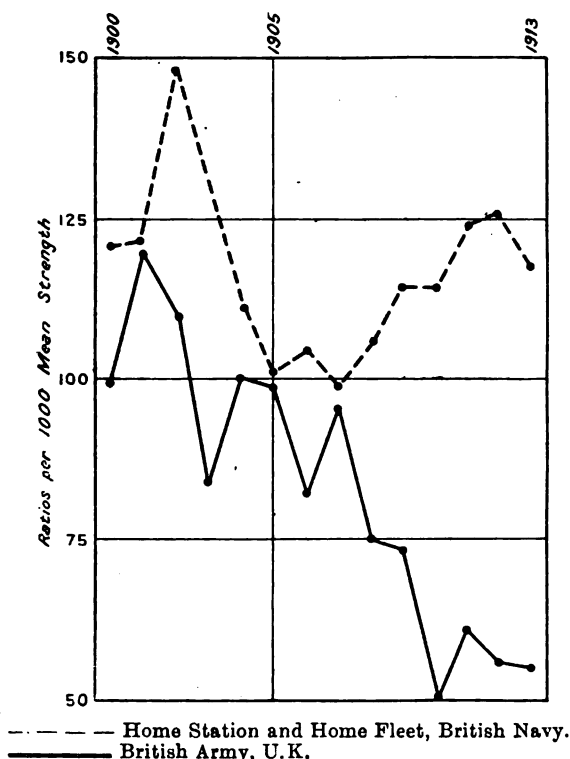


CHART 3.

Admissions to hospital for total diseases of the digestive system, 1900 to 1913.

Naval and military figures show some curious contrasts in the period under discussion; for example, the curves for diseases of the digestive system. Chart 3. The curve for deaths from respiratory diseases among the registered population of British India for the available period shows an increase which, if a real one, is striking, because it concerns such a huge aggregate, -viz., 238 million people at the present time. I feel very sure that this increase in deaths attributable to respiratory diseases marks a real and world-wide increase in this class of illness. Chart 4. I consider

that everyday clinical experience supports this opinion. No doubt the purely statistical consideration of such a question would require much study. No figures relating to morbidity for non-notifiable illnesses are available for any civilian aggregate as far as I know and so they cannot be examined. Such facts relating to the matter as are reasonably accessible support the view that the new influence that got going in 1905 was not restricted geographically as regards its field of activities.

With regard to admissions for nasal catarrh and "colds" and so on, it must be remembered that admissions under these heads were formerly very few, and their sudden increase marks, I think, a sudden increase in the coryzal element in cases which would otherwise have been diagnosed "influenza" or "bronchial catarrh" on clinical grounds. In the early post 1905 period especially, there were frequent outbreaks of febrile illnesses marked by extreme coryza. It is unfortunate that the figures for nasal catarrhal conditions for prisoners in Indian jails are not available after 1910 and I do not know how nasal catarrh affected them after that date. Chart 1. There are roughly some 110,000 prisoners annually.

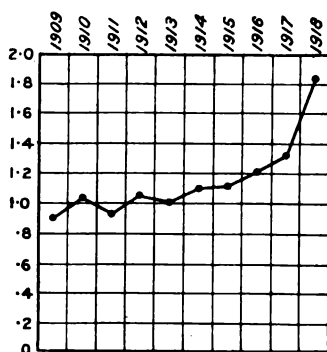


CHART 4.

Civil population of British India.
Death-rate per mille for respiratory diseases, 1909 to 1918.

There can be no doubt that respiratory infections are now much out of hand and, moreover, the tendency to this was observable for some years before the war years. The prognosis in regard to these conditions has altered very much before one's eyes in the short period of the past decade or rather more. For example the prognosis in pneumonia with regard to life seems to me, on the whole, to have become distinctly worse. The prognosis, however, in the major respiratory illnesses with regard to the proper resolution of the inflammatory process and proper recovery has become very much worse. About this I think there can be no doubt. In these days to suffer an attack of pneumonia or pleurisy or bronchitis is to run a noticeably greater risk than formerly of being permanently weakened

to be left more or less of a lung cripple. At the present time the alteration here, both in regard to quantity and quality, is in clear focus.

For some reason our resistance to many common air-borne infections stands at a dangerously low level and our resources against them continually trench on our reserves.' At one point our resistance to the respiratory infections crumpled up completely and, in 1918, a pandemic resulted which just gave us a glimpse of how such a disaster might exterminate us. There were, for instance, nearly eight million deaths in British India in a few weeks in 1918; to be exact 7,089,694, i.e., 29·7 per mille of the population. The amount of disability short of death is not recordable.

If objective example is needed of how the major respiratory infections were increasing independently of the Great War and its upheavals in the countries concerned, we may notice the soaring death rates for pneumonia in nearly every State in the United States of America in 1915. The pandemic was no accident of a bad health year, nor a pure result of war conditions.

If there has been a new adverse influence abroad of late years it certainly has not been in any way restricted to highly civilized countries, but has affected equally countries uninfluenced by civilization as regards general mode of life, diet, etc.

Environmental and nutritional defects resulting from city life and similar considerations have no direct say in this new phenomenon which has been produced entirely by zymotic disease.

To the hypothesis here outlined there are various criticisms which will at once occur to anyone interested in such matters and which may be at this point touched on. You may say that the few figures quoted do not of themselves certainly indicate such an abrupt onset of the hypothetical phase as I premise. As to that, there may quite well have been some kind of prodromal period, but, in my opinion, the thing matured suddenly as described and I will shortly give in more detail my reasons for so thinking.

One may also feel inclined to suppose that the position at the present time must indeed be the aftermath of war and its epidemics. I think, however, that the view is tenable that the war only exaggerated very definitely pre-existing tendencies.

These opinions have also been criticized as follows: That the *suddenness of the origin* of the new phase (here premised as beginning after the first few years of the present century had elapsed) is indefinite, and that whatever is admissible *re* an unsettled state in infective disease is to be largely attributed to ever-increasing facilities for travel and intercommunication bringing non-immunes into contact with foreign strains of infection. Without any doubt this consideration is an important one, and this has I believe been often proved. As mentioned above, however, I shall give reasons for believing in the sudden origin of the bad phase and to me therefore there seems no reason why increasing intercommunication, etc.,

after being well tolerated for many years, should suddenly turn round and deal with us in this new fashion.

I believe that the post 1905 influence came to reverse the falling tide of admission and death-rates all over the world in about 1913 and that this effect was merged in the great war. In Chart 5 are three curves particularly illustrating this, and a fourth that for the American Navy, which illustrates the post 1905 activity in the figures for total diseases. There is, however, little to be argued with any confidence from these figures on their own merits, and the fact that this effect was not statistically regis-

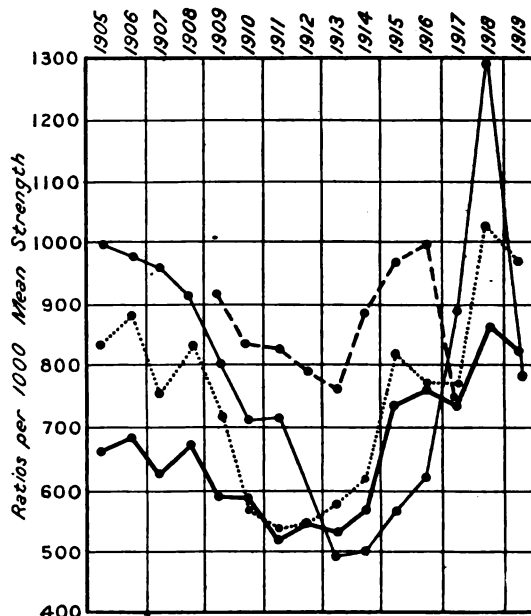


CHART 5.

Total admission rates.

- British Army, India (all causes).
- Native Army, India (all causes).
- American Army in U.S. (disease only).
- — American Navy, total force. Admissions and readmissions (all causes).

Note 1.—No expeditionary force cases of the late war are included in the above.
 Note 2.—America became a belligerent in the late war in April, 1917.

tered earlier than 1913 is if anything rather an argument against these views. I will venture to prophesy that the present comparatively high admission rates for the Services will prove difficult to reduce; here again you may say that it is not to be expected that they should be anything but considerably higher than pre-war rates for various obvious reasons. Had the war not intervened I think that the course of the curves in some of these charts would have been interesting indeed. As it is

American figures up to 1916 inclusive owe nothing to the late war and illustrate something of what I mean.

Again while on that point, a comparison of the admission and death-rates for any of the services of this and other countries to-day with those of thirty or forty years ago shows that the ratios have steadily decreased in recent years. On this count alone you may say that the suggestion of any grave defect in the general health becomes untenable, or even absurd. And yet we live at a time when the general average of health has been emphatically stigmatized as being deplorable by the authorities concerned with the National Service Boards, not only in this country but also in America, and I believe elsewhere besides. In this country, as a matter of fact, these boards were instituted somewhat late and the men examined were not properly representative of the men of military age of the United Kingdom. As far as could be ascertained, however, only one man of military age in three was fit for general service. This bad general average was not confined to those working at admittedly unhealthy occupations, though naturally it tended to be worst among them. On the whole, it extended indiscriminately to the whole bulk of men examined and for this reason, no doubt, it was regarded so gravely.

The new endemicity of the respiratory infections, the new periodontal disease and gingivitis,¹ the latter day upward leap of surgical acute abdominal disease and other signs of the times do something to negative the satisfaction to be derived from the study of vital statistics.

(To be continued.)

¹ Vincent's disease is inexplicably prevalent on the Continent. A number of German writers have commented on it, and many deny that the late war is to be considered responsible for it.

THE PRINCIPAL DISEASES PREVALENT IN THE RUSSIAN ARMY (CENTRAL GROUP OF THE FRONT) DURING THE PERIOD 1914-1916 AND THE STRUGGLE AGAINST INFECTIOUS DISEASES.¹

BY PROFESSOR COSTANTINO KRZYSZKOWSKY.

Colonel, Army Medical Services, late Chief Medical Officer at the General Inspectorate of Health attached to the Supreme Command of the Russian Army.

UP till now, no data have been published regarding the diseases which were prevalent in the Russian Army during the War 1914-1918.

Nevertheless, on account of the nature of the conditions in which the Russian Army found itself during the War, these data afford a certain amount of interest, not only from the point of view of hygiene in general, but also and particularly from the point of view of war hygiene.

The writer of this memorandum who, himself, took an active part in the struggle against infectious diseases on the Russian front, is anxious to give his impressions regarding the struggle in question to his medical colleagues by means of these data.

Deprived of all news from Russia for almost three years, he has not been able to confirm them with the necessary statistical figures, and is, therefore, obliged to confine himself to making known those already in his possession when he was sent with a Mission attached to the Italian Army in the summer of 1917.

These data are official; they were supplied to the writer by the statistical branch of the Army Medical Inspectorate at the Russian front and with the permission of the said Inspectorate were communicated to the "Congress of Pirogoff" of Russian doctors held at Petrograd in the spring of 1916; and later, in 1917, during the mission of the writer on the Allied fronts, to the Army Medical Headquarters of Allied Armies.

Owing to lack of material, the author is also prevented from giving here a complete description of the entire Russian front.

On the other hand, from the point of view of epidemiology such a picture would not be very instructive, so different in every respect were the conditions prevailing on the various sectors of the front.

The description will be given here of only one group of Russian forces, that is, the group which at the beginning of the War was known as "North-western" and later, in the autumn of 1916, as "Western."

In explanation of this it should be mentioned that at the beginning of the War the entire Russian front was divided into the following groups:—

(a) North-western Army group operating in East Prussia and in Poland.

¹ Extract from the "Annali d'Igiene" (Annals of Hygiene), Year XXXI, Vol. 2.

(b) South-western group operating in Galicia.

(c) Caucasian group.

In the autumn of 1915 the northern part of the first group was detached and in the autumn of 1917 the Rumanian group was formed, thus called after the zone of operations.

The writer served with the first group (North-western and later Western), therefore will only deal here with the contagious diseases prevalent in that group.

This group, which included from 1,200,000 to 2,000,000 men, operated in East Prussia and in Poland at the beginning of the War; in the winter of 1915 its front extended along the frontier of East Prussia along the river Bzura (west of Warsaw) as far as Lüblin.

At the time of the Russian retreat in the autumn of 1915, this front occupied the line from Dvinsk to Sarny; the extreme points of this front were not definitely fixed because, for strategical purposes, the Supreme Command united first to one and then to the other the contiguous points of the neighbouring groups.

The struggle against infectious diseases on the Russian front was carried on under extremely difficult conditions, very different from those existing in the Allied Armies.

To begin with, the different units were continually moving over an extended front; later it happened that sections which were operating in the Mazurian swamps for example, received orders to proceed towards the Carpathians. The movements were carried out in thinly populated zones, devoid of sanitary organization even before the War and where the incoming troops were obliged not only to take care of themselves but also to take care of the civilian population. If we add to this the unhealthy climate of the district (Mazurian lakes and Polish swamps) to which most of the soldiers from central Russia and Siberia were unaccustomed, the endemic presence of typhus and the accumulation of masses of troops in a zone where there were no large or provincial towns, the difficulties which the medical personnel of the Russian Army had to contend with will be clear to every epidemiologist.

ORGANIZATION OF THE RUSSIAN ARMY MEDICAL SERVICE.

Generally speaking the Army Medical Service was organized as follows: The administration of the services of a definite zone at the front together with its respective back areas was entrusted to one of the heads of the medical administration under the chief supply officer of the Army group.

The appointment and distribution of medical officers and reserve personnel and supplies for the different armies and units devolve upon the Chief Medical Officer. Without interfering with the regulations of the Medical Authorities attached to the General Staff of the Armies and Independent Units of the Groups, the Chief of the Medical Section of

the group could issue general dispositions with a view to co-ordinating the sanitary measures in the different units and armies of the group itself.

In the back areas the Chief had full powers to act in the struggle against infectious diseases and the local medical authorities both military and civil were obliged to report to him every case of infectious disease, if necessary, by telegraph, and carry out his instructions.

The department of the Head of the Army Medical Administration of the Army Group included the following executive units: a hygiene-sanitary section composed of different medical officers whose duty it was to distribute all available medical personnel, administrative services, material and according to the information received to follow the progress or increase of infectious diseases, allot doctors for special duties; a series of institutions such as mobile and fixed hospitals, the number of which varied and which were allotted from one sector to another to be placed at the disposal of the Supreme Command, according to the exigencies or requirements of this or that group. In addition there were reserves of medical officers, nurses and hospital orderlies; transportable and fixed laboratories; disinfecting trains composed of 5 wagons and carrying a personnel of 2 medical officers, 8 orderlies and a special disinfecting wagon of the usual type; 4 or 5 of these trains were placed at the disposal of each group; there were also disinfecting squads of a lighter type. In addition to this, representatives of the Red Cross and of public organizations (Union of Towns and Zemstvos) were attached but not subordinate to the medical administration of each distinct group, the latter being thus in a position to consult with them on every occasion and extremely advantageous in cases where it was necessary to take prophylactic measures for the civil population.

As a general rule, as soon as any case of infectious disease was reported in the Army, it was the duty of the medical officers to take the necessary measures to fight against and localize the infection. No action was taken by the administration of the Army Group unless the measures taken were unsuccessful or held to be insufficient.

In the Army, the administration of the Army Medical Section was entrusted to the head of the Army Medical Section of the Headquarters Staff.

Up to May, 1917, this post was filled by an officer (Colonel or Major-General) who was not a medical officer (!) assisted by a medical officer sometimes of the rank of General. A medical officer, specialist in hygiene, was attached to this department, having at his disposal a laboratory suitably fitted for chemical-bacteriological research, a disinfecting squad, and organizations similar to those of the Red Cross and the unions of towns and Zemstvos and a hospital for infectious diseases (mobile or fixed).

As a general rule these hospitals were located in the vicinity of railway stations and formed part of the Army Medical and War Organizations as a

whole, known under the name of "evacuation centres" (evacuation stations) exclusive to the Russians and which may only be compared to the British "casualty clearing stations." The "evacuation centres" of each single group were known as "main centres" and were situated near terminus stations, if possible, close to the front line or along the railway line of communication parallel to the front itself. In a word, they were medical centres composed of a certain number of mobile hospitals, a chemical bacteriological laboratory, a disinfecting room, a laundry, baths, medical stores, material for disinfecting linen. A reserve of medical officers and hospital orderlies was attached. An officer (non-medical) was in charge of these centres, assisted by a medical officer to deal with the technical medical administration of the centre. The work of these medical units was the evacuation of the sick and wounded toward the back areas.

The "main centres" come within the competence of the head of the medical service of the Army Group who had authority to change their position if he considered it advisable. These main centres also included tents for patients suffering from infectious diseases and finally acted as centres of inspection for the hygienic conditions prevailing on the railways and in the stations within the zone in which they were situated.

Similar centres were installed in the back areas, the only difference being that here the hospitals were not mobile but of a stationary type; they were known as "base hospitals."

In some of these back areas (Vitebsk, Gomel, Bobruisk) there were hospitals for infectious diseases capable of accommodating from 2,000 to 3,000 patients each. These hospitals were of modern type, situated outside the town. They were composed of special wooden huts (to take from thirty to forty persons each), large chemical bacteriological laboratories, steam laundries, sewage disposal, etc. (at Vitebsk they had tanks for the biological purification of impure water). Finally, scientific meetings of the military and civilian medical officers in the zone were held at the "evacuation centres."

Passing to the sanitary organization of the Army Corps, it should be remarked that the chief medical officer of the corps, "Corps Medical Officer," enjoyed a certain autonomy with regard to the medical measures to be carried out. As a general rule a Surgeon-General was placed under the Army Corps Commander. Attached to him as adviser in matters connected with hygiene was the medical officer, head of the "hygiene-medical" section which consisted of a small mobile squad (five two-wheeled field-carts) whose duty it was to inspect the hygienic conditions of the zone in which the troops were distributed, the sources of drinking water and to notify the first cases of infectious disease and give instructions to the medical officers on matters regarding hygiene, etc. The section included hospital orderlies, nurses and two medical officers, namely, a senior medical officer—hygienist, as he is called—and an assistant medical officer, microscopist. In addition to these the chief medical officer of the corps had at his disposal, when required, private auxiliary organizations and special sections (hydro-mechanical, baths, food supply, etc.).

124 *The Principal Diseases prevalent in the Russian Army*

The chief medical officer of a division was a Colonel or Colonel Commandant who had under his command the medical officer, head of the disinfecting section together with the mobile room, universal type (Prochoroff method).

The disinfecting section was provided with the necessary materials, supplied without any formalities from the field-depots of medical supplies at the evacuation centres in the vicinity. One of the travelling hospitals of the division (there were two of them, each containing 210 beds, of which 200 were for the men and 10 for the officers) was reserved for infectious and suspect cases. The research work connected therewith was carried on either in the army corps laboratories or in the laboratory of the nearest "evacuation centre" (casualty clearing station). A few of the hospitals were fitted with a laboratory of their own.

There were also private auxiliary organizations attached to the chief medical officer of the division, which distributed hot food and drinks (tea) to passing troops and rendered great assistance in the struggle against the cholera epidemic among the refugees from Galicia during the retreat of 1915.

Such were the broad lines of the medical organization of the Russian Army; an organization adequate in itself and endowed with sufficient mobility and elasticity to explain the reason why Russia lost such a small quantity of medical material in the retreats from Eastern Prussia and Galicia. This is an example worthy of imitation by the other Allied Armies in which, on the contrary, there was always a tendency to render the medical services less mobile, with the result that no small quantity of excellent medical material was lost in cases of retreat owing to their inability for rapid evacuation.

GASTRO-ENTERIC.

At the beginning of the war, the personnel of the units in the Russian Army was excellent, composed as it was of young men who were well fed and still better equipped. To this may be added as a factor of no less importance the high moral and spirit of exaltation which was to be found in all classes of society, and in the Army where the War was looked upon as a war of liberation for their Slav brethren.

Infectious diseases began to make their appearance at the end of September, 1914, at first under the form of ordinary gastro-enteric disturbances caused by bad drinking water (marshes of Poland and East Prussia, tainted wells and rivers). Upon analysing the water in several East Prussian positions in the zone Margrabow, Lyk, Angerburg, the author nearly always found chlorine and nitrous acid, indicating that the water had been tainted by organic residue. When we consider the masses of troops constantly and rapidly moved through these posts, or how in certain places the regiments would only remain a few hours, it cannot

be wondered that a rigorous system of hygiene was not maintained in each separate locality.

Nevertheless, all the necessary precautions were taken by the medical officers to ensure the Army against infection by water-borne diseases and safeguard the purity of the springs.

All suspected wells were closed. For this reason sometimes there was an absolute scarcity of water; this was not surprising when, for example, in some villages where the housing accommodation did not amount to more than ten to twelve houses with three or four wells, forces consisting of several thousands of men with horses and baggage were obliged to encamp, the water became exhausted at once and the troops were forced to drink either the muddy water of the ditches or water procured from bogs and marshes. Everything was done to oblige the soldiers to drink water which had been boiled, or tea, but with little result. In this way the question arose as to whether it would not be possible in open warfare which entailed the rapid displacement of large masses of troops, to supply the soldiers with sterilized water. Unsuccessful attempts were made to supply the troops with chlorine tabloids to disinfect the water. Henceforward everything gave place to psychological reasoning. The fear of infection did not trouble those who felt the morrow might bring death; for others the catching of a disease meant delivery from the hard life of war. Then there is the fact that the habits of the Russian masses are not hygienic. Finally, it was hard to expect anyone devoured by thirst to wait until the water had been disinfected apart from the fact that disinfected water, no matter what the method employed, loses in taste and freshness, which are fundamental qualities as regards the slaking of thirst.

In Poland, an attempt was made to remedy this situation by constructing "field canteens" all along the roads followed by the troops, where boiled water and tea were distributed night and day. Boilers containing boiling water and reservoirs filled with cold water which had been boiled were placed outside several of the field hospitals situated along the route followed by the troops. At the railway stations, boiling water or cold water which had been boiled was distributed free day and night. Even when a halt was made or the troops stopped to bivouac, endeavours were made at once to provide the troops with water which had been boiled.

In a word, everything was done to supply the troops with sterilized water. But with all this it was not possible to safeguard the troops from gastro-enteric troubles. This is not difficult to understand when we consider that in order to guarantee oneself against infection by means of water it was not sufficient, in view of the impure conditions of the soil and water in East Prussia and Poland, to confine oneself to the use of sterilized water alone as a drink; sterilized water should also have been employed for other personal requirements, to which nobody even gave a thought.

No small share in the appearance of gastro-enteric troubles was due to

contact with the local population. Although the daily food ration distributed to the troops was more than sufficient, the soldiers were always inclined to buy something extra, and it can be easily imagined how tainted the foodstuffs may have become owing to the lack of cleanliness of the population, the accumulation of refuse left behind by troops who had previously passed that way, and the enormous amount of flies and other insects. The authorities also endeavoured to fight against these factors but were not always successful. Out of the total number of troops, considerable percentage were affected with gastro-enteric diseases. The largest number of cases occurred during periods when movements of troops on a large scale were being effected and when fighting was in progress. During lulls when the troops remained more stationary (October, 1915 till the summer of 1916) the number of cases was reduced to one per cent, which was due to the fact that during periods of greater calm it was easier to supply the troops with sterilized water.

ABDOMINAL TYPHUS (TYPHOID FEVER).

On account of the above-mentioned conditions, it can be easily understood how soon (September, 1914) cases of typhoid, with which 2·5 per cent of the troops were already affected in October, 1914, were to occur side by side with gastro-enteric troubles. In East Prussia (for example, at Lyk) entire hospitals were filled with cases of typhoid from the 10th Army. Although in peace-time typhoid does not give cause for serious apprehension as regards infection and death percentage, in war-time it becomes a regular plague in the Army and puts the Medical Services to a severe test. It renders the soldier helpless for several months and fills up all the hospital beds so urgently required in time of war.

The percentage of cases of typhoid between December, 1914, and January, 1915, was not very high; afterwards the epidemic abated, the percentage of cases being maintained between 1·6—1·2 per cent during the spring and summer of 1916; in October, 1916, it increased again. At that epoch anti-typhoid inoculations were begun and the epidemic abated, the percentage of cases remaining very low during the spring and summer of 1917 (0·2—0·4 per cent). There is no doubt but that great responsibility is attached to the War Ministry for sending soldiers to the front during the war who had not been inoculated against typhoid. The British Expeditionary force which landed in France consisted of a contingent of men nearly all of whom had been already inoculated and were immune from typhoid. In justification it may be quoted that at the outbreak of war the medical services of the Russian Army were not as independent as those of the British and in many questions of a strictly technical nature were under the orders of the non-technical military authorities.

The same thing happened in the French Army where the administration

of the medical services was entrusted to military officers without medical qualifications.¹

The Army therefore entered the war without having been previously inoculated; the inoculation of the troops was begun long after the first cases of typhoid had made their appearance. These examples are instructive and show the influence of certain ancient traditions by reason of which in the armies of olden times the administration of the medical side was with difficulty entrusted to medical specialists.

Medical war organizations, specially as regards military hygiene, are so complicated and require such particular knowledge and preparation that it is impossible to entrust the life and health of the soldier to officers of the general staff with impunity, without serious consequences to the Service.

The British Secretary of State for War, who understood this elementary truth, when forming the Army cadres, at once confided the administration of the Army Medical and Sanitary Services to medical specialists, creating an independent medical corps of these services (Royal Army Medical Corps). In this way the greatest scope was afforded for the exercise of initiative in the medical and hygiene services of the war, in accordance with the actual teachings of science, this being rendered all the more easy by the fact that the most important representatives of the science such as, for example, in the field of hygiene, Professor Beveridge, and bacteriology, Professor Leishman and Professor Wright, were called to co-operate in these services. And in fact, when visiting the British front and those of the other Allied Armies, we were able to state that in the British Army alone did the medical services attain the desired standard, all the modern teachings of science were applied to prophylaxy and clinical medicine. And this because, in the British Army alone, the medical officers are independent and free throughout to carry out the measures suggested by their own particular scientific competence.

When abdominal types appeared, the sanitary measures were increased particularly as regards the supply of water. In the autumn of 1915, as soon as the military operations assumed the character of static warfare, hydro-technical sections were immediately established, under the control of each Army Corps.

These sections disposed of technical experts and engineers whose duty it was to provide for the improvement of water reservoirs and construction of new ones. For technical reasons it was not possible to treat the water with chlorine since owing to the concentration of large masses of men on a relatively limited area and the frequent movements of the troops themselves

¹For one result of this it is sufficient to read the words of the celebrated Belgian surgeon, Depage: "Have we not seen practitioners of high-standing and world repute serving as ordinary stretcher-bearers?" (Report of his journey to the French front, *La Press Médicale*, 1918, 17-1, N. 4.)

large quantities of water could not be disinfected for lack of technical material.

They had to be satisfied with water from the wells (Norton), every possible measure being taken to safeguard them against infection.

ANTI-TYPHOID INOCULATION.

There is no doubt but that the most radical measure to have taken would have been to inoculate the Army. Unfortunately, however, the system of bureaucracy and routine which prevailed in the Army Medical Administration up to the outbreak of war, not only prevented any steps being taken to introduce this important prophylactic measure, but also even during the War, when the experiment tried by the British Army must have already been known to the Army Medical Administration at the Russian Ministry for War, there were sceptics who had doubts as to the harmlessness and utility of preventive inoculation! One of the most stubborn opponents of preventive inoculation, for example, was the Director of the Medical Services of the Armies of the South. It required all the efforts of the reserve medical officers and, in particular, of the doctors attached to private organizations, as the Union of the Zemstvos (particularly those under Professor L. Tarassiewitsch and Professor Carafa-Korbut) who organized an extensive propaganda in connexion with the necessity for vaccination on a large scale, to enable this to be put into practice.

Preventive inoculation was favoured by the late Czar Nicholas II., who was always deeply interested in matters connected with hygiene in the Army.

At the end of the summer of 1915 orders were issued whereby inoculation against typhoid were obligatory in the Army in the field. On the Western front (Western Group) which is the subject of this report, the practice of inoculation began in December, 1915, and by March, 1916, nearly all the soldiers and most of the officers had been inoculated.

Thanks to the assistance of the Chief Medical Officer of the Western Group, Surgeon Lieutenant-General V. Hubbenet, the campaign against typhoid was progressing favourably. Considering that this was the first experiment of the inoculation of troops in a body, made during a period of military activity and trench life and that it was still opposed by a good many sceptics, the best possible measures were taken to provide against any eventuality which might occur to discredit vaccination. Therefore, the duty of performing the inoculations and the supplying of the vaccine were entrusted to a special Commission composed of Army medical officers and doctors belonging to private institutions posted near the Medical Administration of the Group. Commissions composed of competent medical officials were formed and attached to the Army General Headquarters. In the Army Corps and equivalent commands these organizations and the control of inoculation were entrusted to the medical officers, experts in

hygiene, belonging to the respective corps. In this way it was possible to inoculate almost two million men and great faith was reposed by the troops in this prophylactic measure. The supplying of the vaccine was undertaken by the Panrusa Union of the Zemstvos (i.e., Provinces) with the concurrence of all the more important bacteriological institutions in Russia.

The vaccine supplied by the union was of the Kolle type and contained an agar culture of Eberth's bacillus. The bacteriological laboratory of the War Ministry supplied vaccine cultured in bouillon, Wright's method.

This last vaccine was insufficient as regards quantity, causing in addition frequent local reactions generally of a fairly intense nature; for this reason it ended by being used solely in the back areas.

All vaccine, before being distributed for use, had to pass through a control laboratory at Minsk where the purity was tested, and the absence of living bacilli certified and experiments carried out upon human beings. It is true that it was soon admitted that the action of the inoculation varied according to whether it was used in the back areas or in the front line; nevertheless the tests were continued and only after it was ascertained that it was capable of checking the disease in the case of men of all categories, was it distributed for use in the Army.

Two injections were made (a double quantity of vaccine being injected the second time) with an interval of seven to eight days between each. The results obtained and the scientific observations made were published in the "Scientific Meetings of the Medical Officers of the Western Army Group." One of the Armies (2nd) adopted on its own initiative the practice of simultaneous inoculation against typhoid and cholera which gave excellent results. The action of the bivalent vaccine was not so intense as that of the monovalent (Dr. Voskresensky).

As already stated, almost all the troops forming the group had been inoculated by March, 1916, as a result of which the number of typhoid cases during the Spring and Summer of 1916 fell. At the end of the summer re-inoculations were begun.

On the whole the results obtained by inoculation correspond in every respect to those ascertained by us on the French front.

It is not without interest to note that for the most part the officers refused to allow themselves to be inoculated and that only a few of the doctors submitted to it.

(To be continued.)

Clinical and other Notes.

INFLUENZA AT THE CURRAGH CAMP, CO. KILDARE, 1921.

BY MAJOR J. E. H. GATT.

Royal Army Medical Corps.

THERE have been two distinct epidemics this year. During February and March, a small outbreak of mild cases of catarrhal type. The units chiefly affected were the 10th Hussars and the 12th Lancers. Between this and December, sporadic cases of all types occurred throughout the year, varying from mild catarrh to severe catarrhal pneumonia of the 1918 type (one case only—August) characterized by severe toxæmia and profuse sero-sanguineous exudate.

During August and September, a series of very mild type characterized by exanthems occurred among civilian internees in Rath Camp.

The disease broke out in epidemic form, first among the Duke of Wellington's Regiment during the first week of December, forty-five cases having been admitted to hospital from this unit by the 18th of the month. It was probably imported by a draft which had joined two or three days previously from Halifax. All other units were subsequently infected but to a much less extent.

The prevailing type of this epidemic was characterized by sudden onset with rigors and high fever, general malaise, vague pains all over with marked headache and definite sore throat. Catarrh was much less marked.

Types of Temperature.—The most common type was three days' fever, with sharp crisis or rapid lysis. The next most common was four to six days' fever, with a marked drop on the second day, followed by a second rise, so as to give the chart a very marked saddle-back type. The initial rise was often 103° or higher with rigors. In at least three cases a relapse occurred after six days' fever with an intermission of twenty-four to forty-eight hours. There were six cases of pneumonia, all of a similar clinical type, quite different from the 1918 type.

The Exanthem.—This was first observed during March in two cases of mild type. During August and September about sixteen cases came under observation in Rath Camp.

Within a few hours of the onset a rash appeared generally on the trunk, deltoid regions and proximal segments of the limbs. In a few cases the forehead and face were involved in a dull red flush of a more uniform character. The hairy parts and those most subject to pressure showed most rash; the coarse appearance was not unlike rubella, but with a magnifying lens the prevailing type was obviously an erythema, chiefly affecting the pores of sweat glands and the base of hairs. A few stray papules were discernible here and there with in most cases one or two petechiæ. One of the last cases became completely purpuric on the third day.

During the December epidemic, which was undoubtedly the same as reported from all parts of the Kingdom, exactly similar¹ rashes to those already described were observed in about fifteen per cent of all cases which passed through the wards of the Curragh Hospital. The prevailing type was a modified scarlatiniform flush without being so bright or so typically punctiform.

The rash was in all cases of a fleeting nature, but a fine branny desquamation on the face was observed once.

Glandular Enlargements.—These were observed in several of the cases that occurred in the first half of the year; some of these relapsed. The neck was the most common region affected. One case, with erythematous exanthem, during August developed this condition more extensively with enlarged and tender spleen, and longer course. This case resembled the description of glandular fever given by certain observers.

Bacteriological Findings.—(a) Throat: Throat swabbings in February and March yielded *Bacillus pfeiffer* and *Micrococcus catarrhalis*. The latter was also obtained in seventy-five per cent of normal throats from persons belonging to infected and non-infected barracks, during the height of the epidemic. Swabbings in August and September yielded almost pure culture of *B. pfeiffer*, which was agglutinated by patients' serum up to 1 in 100. Swabbings in December were characterized by the prevalence of hæmolytic streptococci, together with *B. pfeiffer*.

(b) Sputum: *B. pfeiffer* with hæmolytic streptococci and pneumococci were recovered from the case of pneumonia during August.

(c) Blood cultures: The case of clinical glandular fever already mentioned yielded a diphtheroid bacillus and hæmolytic streptococci. A case with rash in December epidemic yielded *B. pfeiffer* and staphylococci. This case was examined the day of admission.

Post-mortem evidence was not available as there were no deaths from this cause throughout the year.

General Inference.—Influenza was present throughout the year, beginning with a very small outbreak in February and March which was chiefly of a catarrhal and mild nature, continuing in a sporadic and atypical form during each month, and assuming epidemic proportions early in December.

Rashes, generally of an erythematous type, undoubtedly occur in the course of this disease. Generally speaking, they are of a fleeting nature, and do not end in desquamation, though the latter does occur.

Preventive Inoculation.—This was extensively carried out by certain units, a few weeks before the epidemic appeared. Both the old and the new catarrhal vaccine were used.

Though a sufficient number of observations is not to hand, the following statement is, I believe, justified. One unit was completely protected by N.C. vaccine and no cases of influenza were reported beyond a few mild cases of tonsillitis.

¹ It is interesting to note that similar rashes have been reported in England and Scotland by various observers at the same time. In a few cases, the rash was pleomorphic, though predominantly erythema—in one exactly symmetrical and markedly around the principal joints (knees, ankles, wrists).

Influenza appeared at the time in the neighbourhood. Units inoculated when the epidemic had already appeared, but before they were themselves infected to any extent, suffered less severely and extensively than the unit which was not so protected.

None of the cases of pneumonia were protected by inoculation.

REPORT OF SWABBINGS OF SORE THROATS AND TONSILLITIS IN THE CURRAGH AREA DURING JANUARY, 1921.

Date	Name	Clinical	Organisms
6.1.21	Fuller, 6th Dn. Gds. ..	Tonsillitis	<i>B. fusiformis</i>
6.1.21	Tye, R.H.A.	"	Staphylococci
10.1.21	Cope, 1st N. Staffs	"	"
12.1.21	Simpson, 1st Cams.	" phlegmonous	Pneumococci
12.1.21	Tardivell R.E.'s, Billy	" acute	Staphylococci
	" Frank	"	"
	" Olive	"	"
12.1.21	Dean Gracie, R.E.'s	Dirty white membrane on uvula (aphthæ)	"
16.1.21	Flynn, 1st Cams.	Erythema fauces, punctiform red rash	Nil
16.1.21	Jones, 1st N. Staffs.	Tonsillitis	Gram-positive cocci
16.1.21	McKearney, 1st K.S.L.I.	"	Diphtheroids, Gram-positive cocci
24.1.21	Drake, 6th Dn. Gds.	Erythema	Nil
26.1.21	Dawson, 1st Cams.	Follicular tonsillitis	Gram-positive cocci
27.1.21	Holbrook, R.F.A.	Vincent's angina	<i>B. fusiformis</i>
28.1.21	Harding, 1st N. Staffs.	"	<i>B. fusiformis</i>

FEBRUARY, 1921.

3.2.21	Graham, 1st S.R.	Vincent's angina	<i>B. fusiformis</i>
4.2.21	Middlebrook, 6th Dn. Gds.	Tonsillitis	Staphylococci
4.2.21	Kidd, 10th R. Hus.	"	Diphtheroids
5.2.21	Westbury, 1st S.R.	Influenza	<i>M. catarrhalis</i> and <i>B. Pfeiffer</i>
9.2.21	Gilbert, R.A.S.C.	"	<i>B. Pfeiffer</i>
13.2.21	Quinn, 1st S.R.	"	"
13.2.21	Morris, 12th R. Lances.	Vincent's angina	<i>B. fusiformis</i> and diplostreptococci
16.2.21	Sutherland, 1st S.R.	Tonsillitis	"
16.2.21	Thompson, R.F.A.	Erythema	<i>B. fusiformis</i> and diphtheroids
17.2.21	Young, 10th R.H.	Influenza	Diphtheroids
20.2.21	Chuter (Capt., R.G.A.) (Galway)	Tonsillitis	<i>M. catarrhalis</i> and <i>B. Pfeiffer</i>
20.2.21	Alexander, 6th Dn. Gds.	Influenza	" " "
20.2.21	Gibbons, 6th Dn. Gds.	"	" " "
20.2.21	Spall, 12th Lances.	Double pneumonia	" " "
21.2.21	Clark, 1st Leics.	Influenza	" " "
22.2.21	Eade (Mrs.), 1st N. Staffs	Tonsillitis	" " "
23.2.21	Griffiths, R.F.A.	"	" " "
25.2.21	Ironside, 1st S.R.	Angina	<i>M. catarrhalis</i> and hæmolytic streptococci
28.2.21	Isom, 1st N. Staffs	Influenza	<i>B. Pfeiffer</i> and hæmolytic streptococci
28.2.21	Claxton, 12th Lances.	"	<i>M. catarrhalis</i> and <i>B. Pfeiffer</i>

REPORT OF SWABBINGS OF SORE THROATS AND TONSILLITIS IN THE CURRAGH AREA DURING MARCH.

Date	Name	Clinical	Organisms
1.3.21	Scarratt, 1st S. Rifles ..	Chronic enlarged tonsils	Staphylococci
2.3.21	James, 12th Lancers. ..	Tonsillitis, fever ..	Pneumococci
2.3.21	Lafferley, R.A.M.C. ..	Headache, catarrh ..	<i>M. catarrhalis</i> and <i>B. pfeiffer</i>
5.3.21	Roberts, 1st N. Staffs. ..	" " ..	" " "
7.3.21	Jones, K.S.L.I. ..	" " ..	" " "
7.3.21	Watson, R.F.A. ..	Angina ..	<i>B. fusiformis</i>
7.3.21	Sample swabbing of one barrack room, 10th Huss. (19 men), throat swabs	.. ..	<i>M. catarrhalis</i> in all throats, associated with hæmolytic streptococci in three, with <i>B. pfeiffer</i> in one
9.3.21	Sample swabbing of one barrack room, 12th Lancers. (16 men), nasopharyngeal swabs	.. ..	<i>M. catarrhalis</i> in all but one, associated with diplostreptococci in one, with <i>B. pfeiffer</i> in one, <i>B. septus</i> in two
12.3.21	Sample swabbing of one barrack room, 1st N. Staffs. (12 men), throat swabs	.. ..	<i>M. catarrhalis</i> in seven; ordinary Gram-positives in others
15.3.21	Liddle, R.E. ..	Sore throat, fever ..	<i>B. fusiformis</i> with <i>B. pfeiffer</i> and spirochaetes
16.3.21	Jackson, K.S.L.I. ..	" " ..	<i>B. pfeiffer</i> and <i>M. catarrhalis</i>
21.3.21	Browne, 1st Suffolks ..	Tonsillitis ..	<i>M. catarrhalis</i> and staphylococci
21.3.21	Bendall, 1st Suffolks ..	" ..	Diphtheroids, staphylococci
23.3.21	Sample swabbing of one barrack room, K.S.L.I. (12 men), naso-pharyngeal swabs	.. ..	<i>M. catarrhalis</i> in eight, associated with long streptococci in one; staphylococci in all
24.3.21	Savage, 2nd Suffolks ..	Tonsillitis, headache, fever	<i>M. catarrhalis</i> and <i>B. pfeiffer</i>
25.3.21	Clark, 2nd Suffolks ..	Angina ..	Staphylococci, diphtheroids
3.21	Recketts, 1st N. Staffs. ..	Influenza ..	<i>B. fusiformis</i> with spirochaetes

APRIL.

1.4.21	Pte. Armour, R.A.M.C. ..	Erythema of fauces ..	<i>M. catarrhalis</i>
3.4.21	Miss Ryan, V.A.D. ..	Catarrh ..	"
7.4.21	Pte. Rudd, 2nd Suffolks ..	Tonsillitis ..	<i>B. fusiformis</i> , spirochaetes, streptococci
9.4.21	Pte. Ironside, 1st Cams. ..	Tonsillitis and cervical glands	<i>M. catarrhalis</i> and hæmolytic streptococci
11.4.21	Gnr. Nicholls, R.F.A. ..	Catarrh, headache, fever, morbilliform rash	<i>M. catarrhalis</i> and <i>B. pfeiffer</i>
14.4.21	Pte. King, 9th Lancers. ..	Chronic rhinitis, adenoids	<i>B. diphtherie</i>
14.4.21	Pte. Egerton, 1st N. Staffs.	Encephalitis ..	Hæmolytic diplostreptococci
16.4.21	Pte. Winter, 1st Cams. ..	Tonsillitis ..	Hæmolytic diplostreptococci and <i>M. catarrhalis</i>
17.4.21	Pte. Kellaway, M.F.P. ..	Erythema of fauces, catarrh and fever	<i>Strepto. viridans</i> and <i>M. catarrhalis</i>
18.4.21	Gnr. Dicks, R.F.A. ..	Follicular tonsillitis ..	Common pyogenics
19.4.21	Gnr. Smith, R.F.A. ..	Erythema of fauces, cervical gland	<i>M. catarrhalis</i> and <i>B. pfeiffer</i>
21.4.21	Pte. Sweetman, 1st Cams.	Follicular tonsillitis ..	<i>B. fusiformis</i> and common pyogenics
22.4.21	Pte. Laffling, R.A.M.C. ..	" ..	Hæmolytic streptococci
23.4.21	— Green, M.F.P. ..	Erythema of fauces with foetid sloughs	<i>B. fusiformis</i> , spirochaetes, <i>M. catarrhalis</i> and hæmolytic streptococci
25.4.21	Pte. Savage, 2nd Suffolks	Enlarged tonsils, fever	Staphylococci

REPORT OF SWABBINGS OF SORE THROATS AND TONSILLITIS IN THE CURRAGH AREA DURING MAY.

Date	Name	Clinical	Organisms
3.5.21	Kirkward, R.F.	Tonsillitis	Hæmolytic diplostreptococci
4.5.21	Pergilly, 1st Cams. ..	Chronic tonsillitis and occipital headache	„ „
4.5.21	Boy Titley, 1st N. Staffs.	Erythema	<i>M. catarrhalis</i> and staphylococci
8.5.21	McGregor, 1st N. Staffs...	Tonsillitis	Hæmolytic streptococci, <i>M. catarrhalis</i> and staphylococci
10.5.21	Buckley (Civilian) R.A.S.C.	„	Fusiform spirochaetes, and <i>M. catarrhalis</i>
12.5.21	Lewis, 1st N. Staffs. ..	„	<i>B. fusiformis</i>
12.5.21	Cross, 1st N. Staffs. ..	Cervical glands	Staphylococci and hæmolytics
15.5.21	Thomson, 1st Cams. ..	Tonsillitis	Hæmolytic streptococci and staphylococci
16.5.21	Barter, R.F.A.	Dirty membrane on tonsils	<i>B. fusiformis</i> and spirochaetes
19.5.21	Meaney, R.E.	Follicular tonsillitis ..	Staphylococci, <i>B. fusiformis</i>
19.5.21	Boy Russell, 1st N. Staffs.	„ „	Diphtheroids, <i>M. catarrhalis</i>
21.5.21	Reeves, 2nd Suffolk Regt.	„ „	Staphylococci, diphtheroids
21.5.21	Terry, R.A.M.C.	„ „	Staphylococci
26.5.21	Lister, R.A.S.C.	Tonsillitis	Hæmolytics and <i>Staphy. albus</i>
28.5.21	Hardie, 1st Cams.	Follicular tonsillitis ..	<i>Strepto. viridans</i> and <i>M. catarrhalis</i>
30.5.21	Boy Lawrence, 6th Dn. Gds.	Tonsillitis, ulcerative ..	<i>B. Pfeiffer</i> and <i>M. catarrhalis</i>

A CASE OF PAROTID TUMOUR.

By G. WOODFORD.

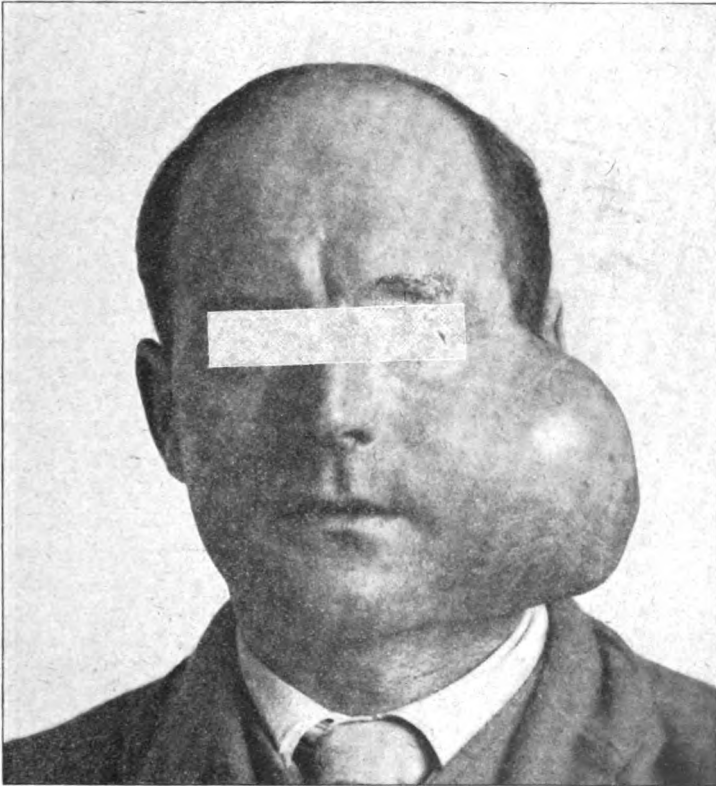
(Late Major Royal Army Medical Corps (T.).)

QMR.-SERGT. F., aged 32, service thirteen years, was transferred to the Military Hospital, Fort Pitt, Chatham, on March 1, 1922, with a large tumour on the left side of the face. He stated that the growth was first noticed ten months ago, and had gradually increased in size, more rapidly during the past three months. He complained that the movement of the lower jaw was restricted and that recently he had noticed some pain—not severe—especially at night. He stated that he had not reported sick and that no medical advice had been sought for the growth, as he was anxious to complete a course of instruction for master gunner before being admitted to hospital, for which there did not seem to him to be any urgency, as he and his friends believed it to be a cyst which could be removed easily at any time.

He was a well-built and fairly healthy man. The chest, abdomen and nervous system did not show any abnormality. A tumour measuring approximately four inches in all diameters was growing from the left side of the face. It appeared to be semi-solid and gave a sense of semi-fluctuation when palpated between the cheek and the inside of the mouth. It could be moved slightly on the jaw, and though movement of the mandible moved the tumour it was not immovably affixed to the bone. The skin was nowhere adherent to the growth. There were

small areas that appeared to be cystic. Sensation was normal. No facial paralysis. No involvement of the eye or ear. No enlarged lymph glands. Parotid secretion appeared to be present and no alteration could be detected in the opening of Stenson's duct.

An X-ray photograph showed some lack of density and irregularity of outline at the left angle of the mandible. The growth was quite transparent to the rays, excepting for a small, semi-opaque area at the upper and outer pole—about 1 o'clock when observed antero-posteriorly. He did not think he had lost flesh. He was seen by Colonel Pilcher, A.M.S.



Erosion of the angle of the jaw.

Diagnosis.—New growth, probably of parotid gland, now showing signs of commencing malignancy. Operation advised. The risk of operation with the certainty of facial paralysis and also the risk of dissemination if no operation were done was explained to him, and he decided to submit to removal of growth.

March 13.—Operation by Mr. Woodforde, C.M.P., surgical specialist. Anæsthetic, open ether (Captain Pottinger, R.A.M.C.). Colonel Pilcher, A.M.S., came down from the Royal Army Medical College to assist and advise. An incision was made from the zygoma downwards, three-quarters of an inch in front of the auricle, exposing the posterior connexions of the growth and turning slightly

forward for two inches along the anterior border of the sternomastoid. A definite capsule existed but it was decided to remove this with the tumour owing to the high probability of malignancy. Many very large veins were found entering the growth and, in spite of preliminary ligature, venous hæmorrhage was free. The anterior connexions of the growth were exposed by a semilunar incision over its most prominent part, joining the first incision above and below. On freeing the upper pole of the growth it was found to be covered by the origin of the masseter, greatly thinned but easily identifiable, and it was obvious that the tumour arose from the mandible. On shelling it out of its bed the tumour was



To show erosion of the angle of the jaw.

found to arise from the angle of the lower jaw, the outer surface of which was rough and eroded. The external table of the mandible was absent for an area of one by three-quarter inches. This area of affected bone was removed with a Gigli saw, and part of the internal pterygoid muscle which was found involved in the growth was dissected away. All hæmorrhage was stopped by ligature and the skin wound closed. A drain was inserted at the lowest part of the incision to deal with the oozing from the extensive bed of the growth.

As the bandages were being applied, the patient became very collapsed and respiration ceased, followed almost immediately by cessation of the pulse. The head down position was immediately adopted and artificial respiration started. Pituitary extract, oxygen and artificial heat were applied; in spite of all efforts and continued artificial respiration no success was obtained and the patient died.

REPORT ON A PAROTID TUMOUR BY THE PROFESSOR OF PATHOLOGY, ROYAL
ARMY MEDICAL COLLEGE.

Gross Anatomy.—The tumour, spherical in shape, was about four inches in diameter and weighed twelve and three-quarter ounces. It was enclosed by a thick fibrous capsule which was clearly demarcated from the surrounding tissues. On section, it was greyish-white in colour and semi-translucent; the main mass of the tumour was firm in consistence, but small areas of softening were in parts evident.

Microscopic Examination.—The stroma and the parenchyma cells were clearly defined. The stroma, scanty in parts of the growth, was in other portions abundant and gave a scirrhus appearance to the section, it formed no definite structure, being in some places intercellular in arrangement, in other situations enclosing groups of many cells.

The tumour cells proper were irregular or polyhedral in shape with small pale vesicular nuclei in which minute multiple nucleoli were an evident feature. A few large pale staining multi-nucleated cells—giant cells—were evident in parts of the section. Regarding the arrangement of the tumour cells, in no part of the growth was there any attempt at acini or tubule formation, but in places there was a definite distribution of the parenchyma in whorls forming more or less occluded channels lined by several layers of flattened cells.

From the above characteristics, it is considered that the neoplasm should be classified as an endothelioma for the following reasons:—

- (1) The absence of any glandular or acinous formation in any portion of the growth.
 - (2) The presence of giant cells.
 - (3) The characters of the parenchyma cells and their arrangement in whorls in part of the tumour.
 - (4) The low degree of pathological malignancy of the growth; it will be observed from the clinical history that it had been in existence for ten months, that no metastasis had occurred, and, further, that no infiltration of the skin or of the underlying bone was present.
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Echoes of the Past.

NOTICE OF A FORM OF ULCER PREVALENT AT DELHI.¹

By A. H. FRASER, M.D.

Staff Surgeon, in Medical Charge of the 88th Regiment.

THE "Delhi boil" or "ulcer"—for it assumes the appearance of the former before it ends in the latter—has been known to be peculiar to Delhi as far back as authentic history can trace; and it is called by the natives "Arungzebe," after that monarch who fell a victim to this form of disease.

It prevails chiefly in the city of Delhi, being less common in the surrounding districts; and at Meerut, about forty miles off, it is unknown. Some places, even in the immediate neighbourhood of Delhi, the natives declare to be perfectly exempt from it, but this may arise in great measure from the population being comparatively few in number.

Various theories have been advanced as to the causes which give rise to this affection. Some attribute it to the influence of malaria; but it most frequently occurs in the winter season, when malaria does not abound. Others think that it arises from an impoverished state of the blood, caused by bad living and impure air; but it equally affects those who occupy good houses, live well, and use every means for the preservation of their health. The natives believe that it arises from the use of the water from the wells of Delhi, which is largely impregnated with salts, chiefly nitrates. In this opinion I am disposed to concur, as a similar form of ulcerative disease has been observed at Mooltan, and in many parts of Scinde, localities the water of which is impregnated with identically the same salts. The greater prevalence of the disease after the rains may also reasonably be ascribed to the rain-water which supplies the wells, taking with it, while percolating the soil, a large quantity of the salts, which, constantly entering the system, change materially the condition of the blood, and induce disease of a zymotic character. The affection appeared in the 88th Regiment, in June, 1859, the corps having arrived at Delhi in the preceding month of February. The men became affected with troublesome sores, which appeared in different parts of the body, and were found to be of a most intractable character. The number of men affected became greater as the season advanced; the greatest increase was from December 1859 to March 1860.

The cases are now (May) on the decrease, the number of admissions during April having been considerably less. From June 1859 to the end of April 1860, 114 men have suffered from this disease, while several of the officers, and many of the women and children of the regiment, have been similarly affected. Four re-admissions have taken place.

The disease first shows itself in the form of a reddish patch, with an

¹ Reprint from Army Medical Department Reports, 1860.

indurated and elevated centre over which the integument becomes smooth and shining, and then assumes a scaly appearance. A small pustule next appears in the centre of the patch, over which there forms a brownish crust, which is somewhat more depressed than the surrounding surface. This becomes gradually larger, particularly if irritated, and is accompanied by pain, and sometimes by a troublesome itching soreness. If the crust be removed, a raw, irregular surface is disclosed, which bleeds freely if roughly handled, and secretes a thin, greyish-brown fluid, more or less transparent, which, on coagulating, forms the crust of an ulcer that continues to extend itself usually in an irregularly circular form. Sometimes a thick crust of a greyish-white colour forms, the ulcer underneath being smaller, with less tendency to spread than when covered with the brown crust. The raw surface consists of flabby, irregular, fungoid-looking granulations, most luxuriant in the centre of the sore, and somewhat tender to the touch. It is at the centre that the reparative process begins to take place, by the formation of a thin pellicle of new skin which extends towards the circumference. This, being arrested by a raw, watery line of demarcation, becomes hard and dry, like parchment, and is at length detached, leaving a deep ulcer, from which flows a thin, brownish discharge, eventually forming a crust, as before-mentioned. The most common seat of this ulceration is the upper extremities and face; less frequently is it met with on the lower limbs, and but rarely on the trunk. No constitutional symptoms are observed during its progress. In some cases, the gums are pale, in others preternaturally red, the alvine evacuations and urine being usually of normal appearance. These ulcers are very apt to break out again; and, when healed, leave a depressed cicatrix, with somewhat elevated and indurated edges, the surrounding integument being scaly and of a purple hue.

Various modes of treatment, both local and constitutional, have been employed, such as the nitrates of silver and mercury; sulphates of zinc and copper; iodine, creasote, and the charred root of the castor-oil plant. Internally, there have been administered iodide of potassium, arsenic, the mineral acids, various tonics, and lime juice. These remedies have been attended with more or less benefit; but my own experience is in favour of destroying the surface of the ulcer, and also a small portion of the surrounding integument, with *potassa fusa*. On the separation of the eschar, a healthy granulating sore is obtained, which heals readily—the constitutional treatment adopted being such as the appearance and state of health of the patient indicate. I likewise have found the sulphate of zinc, in strong solution or in fine powder, most efficacious in producing healthy action in many of the sores. The strong tendency of this affection to return, renders any improvement which may have been obtained by treatment, in most cases, only temporary; and although the disease may become milder, or may cease for a time and appear to have worn itself out, I am of opinion that a change of climate alone affects its complete eradication from the system.

Travel.

AROUND THE WORLD.

BY LIEUTENANT-COLONEL C. R. L. RONAYNE.

Royal Army Medical Corps (Retired).

It was always my intention to go to sea as a ship's surgeon when I retired from the Service. My idea was to "see the world" on a "tramp," and then change to a passenger ship. The chief advantage of a "tramp" or cargo ship is that she usually remains a couple of days at each port, thereby giving a chance to see the place. Not infrequently a week or more is spent, in which case a trip in the country can generally be arranged; whereas a passenger ship lands her passengers, takes in a few stores, and is off again in a couple of hours. A "tramp" ship is one which follows no particular route, but trades from port to port all the world over. But I soon found out that an appointment on a "tramp" was not possible (except perhaps without pay), as, though many of them are fine ships up to five or six thousand tons, they do not exceed this tonnage, and so have not the number of crew (100) for which the Board of Trade requires a surgeon to be carried. The large cargo ships of the leading lines are not "tramps" but have *fixed* routes; however, as luck would have it, I sailed completely round the world in one of these on my very first voyage. I was fortunate to get an appointment in the "Peshawur," one of the best cargo ships of the P. & O. Company and, needless to say, on her things were done first class, just as good as on their best passenger ships—indeed I see a fortune awaiting the cook and baker should they wish to retire and set up shop in London! The "Peshawur" is a splendid twin-screw ship of 16,000 tons displacement and over 10,000 tons cargo capacity; but with a crew all told of only 130, as may be suspected, work was not heavy; however, time went pleasantly enough between work, reading, photography, chess, chatting, sight-seeing and tennis when in port, and writing these notes.

November 12, 1921: Left London yesterday in the teeth of a bitter east-north-east gale; and to-day, before we actually moored in dock at Antwerp, a man came on board selling German razors at three bob each. (He sold four, which were subsequently found to be excellent.)

November 13: Went to mass at the Cathedral; splendid old Gothic building, but interior somewhat marred by the number of windows which do not contain stained glass. "The Descent" and "Elevation of the Cross," by Rubens, are probably the best of some very fine pictures.

November 17: I've plodded through the paddy-fields of Bengal after

the wily snipe; I've crossed a desert of the Sinai seeking the limpid waters of Moses' Well, but never have I returned so weary and foot-sore as to-day, after a day's sight-seeing. Here we are in Antwerp, one of the finest cities of the Continent, yet cobble-stones seem to be all they can rise to in the street line! Even the "best" streets are paved with them, and in many places the foot-paths too. I know nothing so jarring and ankle-racking as walking on cobble-stones. I trust the City Fathers will take a hint and that it will not be necessary for me to keep my eye on them—like the "Skibbereen Eagle" once found it necessary to keep its eye on the Czar. As the "entente" is still on I hope I have not expressed myself too strongly—after all, I think a little licence may be allowed to musings due to an aching sole!

December 7: Having shipped steel girders, and Belgian lace and silk, etc., at Antwerp, we duly moved on to Middlesbrough, where we took in more girders, also coal. At Middlesbrough all sorts of "blast" and other furnaces are continually on the go, and to anybody in search of soot, smoke and fog, I can strongly recommend a trip to the town; but there are some pretty spots in the neighbourhood, especially towards Saltburn. Just before we were actually suffocated, and when I was down to my last clean collar, we weighed anchor and set sail for Immingham, where we shipped more steel. Immingham is eight miles from Grimsby. Very fine and well-equipped docks were recently built there; these were much boomed before the War, but at present the place is suffering from the general set-back to trade. We left Immingham this morning and this afternoon arrived in London.

December 19: During the past ten days we shipped four cadets, as well as a lot of general merchandise at the Royal Albert Dock, and all being spick and span, we moved out and anchored below Tilbury, where yesterday we were busy loading nearly 500 tons of shells and explosives for Malta. Each of the shells weighs more than half a ton. To-day we weighed anchor and proceeded down channel against a fresh breeze from south-west. As soon as we cleared the "three-mile limit" the ship's bond-store was opened, and cigars and a few pounds of tobacco which I had bought at Antwerp were given to me.

December 20: One of the characteristics of a good sailor is he doesn't mind getting wet; I have this characteristic only to a very slight extent, but when it comes to a question of getting squirted on whilst snug in bed, I haven't got it at all. This was my fate last night, every time a sea came up to my window I got a squirt of water over me; as this occurred about every half hour I would be just dozing off when I'd be brought sharply to by a fresh squirt. As the douching went on I began to come to the conclusion I had no further use for the sea, but next morning the ship's carpenter soon put the thing right and I quickly forgot my misery.

December 26: On the 22nd and 23rd we coasted along the south

coast of Spain in glorious calm and sunshine, and at 4 p.m. on the 23rd were off Gibraltar, a gentle breeze from the north-west following us, and the wondrous clearness of the atmosphere greatly enhancing the beauty of the scene, and showing up in bold clear relief the picturesque rock and harbour on the one side, and the rugged uninviting African mountains on the other. A fine Orient mail steamer leaving the harbour added to the picturesqueness.

But as we went along this north-west breeze gradually increased, and on the afternoon of the 24th there were some ugly squalls with thunder and lightning. On Christmas morning it was blowing very hard on our port quarter with a big sea running, but we carried on until 5 p.m. when, owing to some heavy rolls and a nasty list, the ship was brought up and hove to, the motion thereby being immediately changed from the heavy rolling to the comparatively tranquil movement of pitching. It was thus hove to, and "heedless of the night winds bitter that around about us whirled," we ate an excellent Christmas dinner. I will not easily forget the Christmas cake the baker provided. It was covered with a thick coat of sugar inlaid with cherries, almonds and nuts decoratively arranged; of huge size, and rich delicious taste, with just an ideal flavour of sherry. Turkey and plum-pudding were passed *À la Lloyds*. We sang songs; and with a pathos which nearly moved the whole company to tears, we sang the well-known song, of which the refrain goes:—

"Hilly holly ho, sung the Captain, Hilly holly ho, sung the crew,
Hilly holly ho, sung the man on the poop,
And the cook sung a song called soup, soup, soup;
But when the waves like great big mountains ran
Then we sang another song called 'Home sweet Home'
In the Medi-terr-e-a-ni-an."

This morning, though the wind had abated, the list continued, so the after hatch was opened up, and then an awful wreckage presented itself. The great shells had broken loose and shifted to starboard and were lying in all directions, mixed with bits of this and that; they were dangerous to walk on as they were coated with a slippery *mélange* consisting of crushed kippers, bits of torn silks, butter, splinters of packing cases, "cerebos" salt, and gin and bitters, etc. As each shell weighed over half a ton little could be done until Malta was reached. It was said a shell required a striking force of 100 pounds to explode it—so how was it one or more did not go off? But apart from this danger, we had cases of gun-powder and detonators; so, on the whole, our escape seems to have been little short of a miracle.

The last time I was at sea with explosives was on a troopship, on which we had a fire which burnt furiously for three days, and we expected to be blown up any moment—and now this present experience! I'm not going to sea any more with explosives!

December 28: Shopping at Malta. Met M. (he is now a major).

Had tea at their house at Sliema, and a great "buck" about old times at Gib. He has now quite a valuable collection of prizes won at tennis. On the wall was a photograph—an enlargement from a snapshot taken at Campamento, showing their horse being led in after winning a race—but what chiefly interested me in it was, that I appear unconcernedly walking across the foreground of the snap. I have no recollection of this incident.

January 12, 1922: This afternoon, when leaning over the side of the ship, smoking and chatting with one of the ship's officers, we saw a sight right under us, so amazing, and it came before our eyes so suddenly that for a moment we could not realize we were looking at whales. One presented his back, looking like the bottom of a large up-turned boat painted slate colour, and the other had his mighty head raised partly out of water, and was moving it slowly up and down against the side of the other, evidently gently caressing his (or her) mate. They were so close to the ship, we could have jumped on to their backs, and the extraordinary thing was that they seemed quite unconcerned by the proximity of the ship—another few yards, and one or both would have been killed by the bow.

It certainly was a very rare sight, and we continued to watch their wooing a long way astern.

Professional work on board is not heavy, but recently I have been busy with a compound fracture of tibia and fibula, due to the man being struck by a steel hawser when running off a bollard.

January 15: We arrived yesterday at Colombo, and left it this morning after a lemon-squash at the G. O. Hotel. I was not altogether a stranger in Colombo, as in 1906 I put up for a few days in the G. O. Hotel with Major H. of the Corps. With him I went on to Point de Galle, in the south of Ceylon, where we had some good fishing from the native catamaran boats. These are the picturesque native boats one sees in the harbour in Colombo, fitted with "outriggers," consisting of a beam of wood running parallel to the boat, and suspended from two poles. The boats are so narrow, it is practically impossible for two persons to squeeze past one another. Though they are popularly called "catamarans," this term is more correctly applied to the small native rafts on the Coromandel coast. The outriggers make them very "stiff," and they stand a lot of sea, but without them they would capsize with almost every movement.

One of the very few white men in Point de Galle, the agent of the local Bank, invited us to lunch one day. The bank is a large building, and points to the former importance of the town, but it is now out of proportion to requirements, as the place has dwindled down in proportion as Colombo has developed. It contains a wonderful collection of old Dutch furniture—some of the tables and side-pieces almost too massive to move. All beautifully inlaid and richly carved. Even the sitting chairs are

massive, inlaid, and finely carved. I do not pose as a furniture expert, but it occurred to me as I examined them, they ought to fetch something nice if dumped down at Christie's. Anyway, there can, I think, be little doubt as to the genuineness, as the furniture is evidently the remains of that used by the Dutch Generals, Admirals, and other "bigwigs" when Point de Galle was an important Dutch fortress. It was ceded to the British in 1792.

January 26 : On the 17th inst. we crossed the "Line," and it was comparatively cool doing so ; this was partly due to the sun's southern declension, but chiefly due to two days' heavy rain we had. With this exception we have had delightful weather all across the Indian Ocean. This morning we coasted along Australia, and in the afternoon arrived at Fremantle. First impressions of Australia are not favourable : thus we coasted along low brown hills with great drifts of silvery sand swept up on them. As we neared Fremantle, not a single church-spire or lofty building of any sort caught the eye—nothing but very low red-roofed bungalows were to be seen—and this unfavourable impression was borne out by the closer scrutiny of a walk through the streets. Such roads, such dust, everything "Kutchal!" Talk about jerry-built buildings! practically all are built of wood. I never saw such a collection—not a tiled or slated roof in the place—nothing but painted corrugated zinc. True, electric trams run in the streets, but they cannot compensate for the many defects. Population is about 25,000.

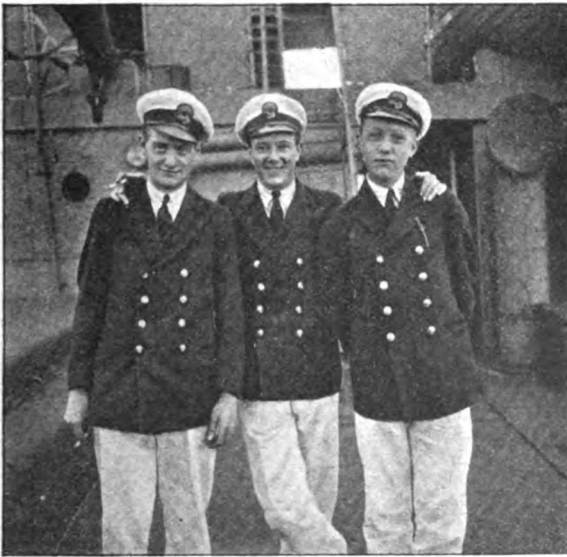
January 27 : Went to Perth—twenty miles by rail. Many fine buildings and shops, open spaces and pretty gardens. Streets laid out on the modern "square" principle. Altogether a fine place, and very different from Fremantle. Numerous small neat bungalows line practically the whole railway route.

January 31 : Left Fremantle on 28th, and are now crossing the Great Australian Bight in delightful weather, accompanied by two fine albatrosses, which are faithfully sticking to the ship. At Fremantle I made the acquaintance of Mr. Ernest Jones, the famous Australian "hurricane" bowler ; he told me several amusing stories. He was often on board in his official capacity in H.M. Customs. I took a snapshot of him, printed it on a postcard and addressed it to "Hurricane Jones, Fremantle."

To-day, after afternoon tea, one of the cadets asked me if I had eaten his plum cake. What happened was—the piece I got looked as if it had been cut, so I went into the kitchen to see, and there I saw a piece on a plate which looked just like mine, so, of course, I ate it. I merely record the incident, as it shows how the present-day youths are being brought up. When I was a cadet's age, I never got plum cake for tea. It seems to me, in this line, there is fine scope for an energetic chief-steward or ship's cook to invent some sort of a cake for cadets. Notwithstanding the best care, rats, weevils, and mould exact a certain toll on the food in the store-room, without at the same time rendering it unwholesome. The cake might be

called "the cadet's bun." Each cadet would get one for afternoon tea. Should a cadet give trouble, perhaps, two buns might be ordered that day.

February 9: We arrived at Adelaide on the 2nd inst., and at Melbourne on the 6th. Adelaide is a fine, up-to-date city, but has the disadvantage of being ten miles by train from the harbour, or Port Adelaide; whereas the docks at Melbourne are only a short mile from the city. Melbourne lacks nothing as regards fine buildings, shops, streets, and public gardens. For picturesqueness I have never seen anything to equal the road leading to the suburb St. Kilda. I have seen "bits" as good as it—but they were only "bits." But to St. Kilda, there are four miles of



CADETS ON BOARD WHO HAVE HAD PLUM CAKE FOR TEA. NO WONDER THEY LOOK HAPPY!

delightful kaleidoscopic effect all the way. On each side the road is lined by artistically built bungalows, each standing in its own grounds, and no two bungalows appear to be of the same design; the grounds surrounding them are so varied and beautifully kept, it is evident the occupants enter into friendly rivalry. On each side, next the footpaths, are asphalt motor tracks, one for "up," and the other for "down" cars, whilst the centre of the road is reserved for horse traffic. This centre is separated from the motor tracks by charmingly laid out flower beds, shrubs, and garden-rockery patches. But no description can adequately convey an idea of such varied and delightful scenic effect, and the route must be traversed to be appreciated.

When first we reached Australia, the whole ship's company was put through a very thorough medical examination by the port medical officer;

and we soon found out, too, that their precautions against rats leaving the ship were not less thorough; but I think the limit was reached about noon to-day when the Dock Rat Superintendent ordered my port to be shut, though it was pointed out to him the ship was about to leave the harbour in a few minutes. He was afraid lest a rat should leap from my window ashore; a drop of about 18 ft.! (I would here mention, more than one ship has been heavily fined for having a port open.) At Fremantle we had to buy a dozen shields for the mooring ropes, to prevent rats leaving the ship along the ropes. These shields consisted of bits of round galvanized sheeting, with a sort of slot in them to fit on the ropes. I should say they were worth about 2s. 6d. each, and would be dear at 5s. They cost 30s. each.

I tried to find out who collared the 30 bob, the Government, or who, but I failed. It was not unusual when in port for a cadet to enter the saloon whilst we were at dinner, and announce that a rat inspector had reported one of the shields on a mooring rope was slightly tilted, and should be straightened immediately.

There were one or two cases of plague in Australia which caused such a scare that the Government offered 6d. for each rat killed.

As a result, rat breeding farms rapidly sprang up, and gave much employment; and as the 6d. was given for each tail, a tail manufacturing industry also developed, in which, it was said, tails were turned out which even experts could not tell from the real thing.

A well-dressed man comes on board ship in the morning, carrying a neat leather suit case or Gladstone bag; before you get to know him, you imagine he is a dealer, and is going to produce jewellery and rare curios from the bag, but on opening it, it is found to be half full of dead rats which he has just collected from other ships. He is the Government rat collector, and is doing his round from ship to ship collecting rats for examination.

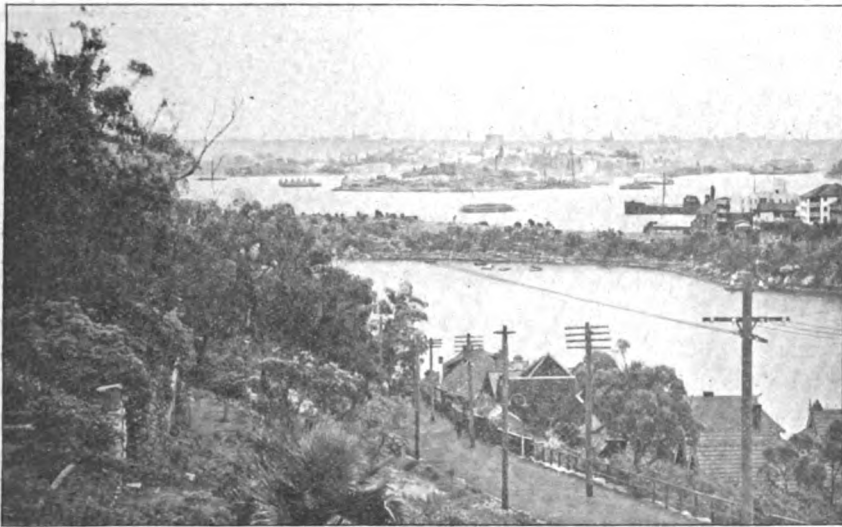
February 14 : On the 9th we left Melbourne. The brown sandy hills of the west and south coast gradually gave way as we came up the east, and we coasted along a rocky coast with hills of green grass, and patches of trees, and bungalows, the latter gradually increasing in numbers as we approached Sydney.

Passing Coogee and Bondi, we were sufficiently close in shore to see, without glasses, the crowds on the sands of these popular seaside suburbs. We entered Sydney harbour about 4 p.m., between its towering rocky cliffs. I have heard much about the harbour, but it exceeded all my expectations. It would be hard to imagine a harbour and general site with a more wondrous combination of business, pleasure, and scenery. The scene, as it quickly unfolded itself after we passed through the rather narrow entrance, was superb. In the near foreground were sloping hills beautifully diversified by green swards, trees, and picturesque bungalows in pretty gardens. In some places hills jutted out and formed small pro-

montories, some of which were completely wooded, the trees extending right into the water, and giving that charming effect so well known on the Lakes of Killarney.

At other places rugged rocks cut off the trees and green hills from the water, and often a small lighthouse, or beacon perched on the rocks, gave a quaint and pleasing effect.

Between these promontories were sheltered sandy coves, with crowds of people on them. Here and there were dotted islands, any one of which made a picture in itself. In the background the smoke from the city was curling up, and many stately buildings stood out and were silhouetted against the deep blue sky, and together with a fine array of merchant ships, and some warships too, gave an air of business and importance. The



SYDNEY HARBOUR (CITY IN BACKGROUND).

picture was completed by the scene of animation on the water itself. As it happened, we entered on Saturday, just as the usual weekly yacht races were in full swing. Such crowds of yachts of all shapes and sizes were under way! their white sails glittering in the sun, and careening to the fine sailing breeze. Large steam ferryboats, like those running between Liverpool and Birkenhead, were plying between Manly, Watson's Bay, and many other suburbs, and were crowded with people in holiday dress. Motor boats, large and small, were running in all directions, and not a few of them were graced by the fair sex, as were also several racing yachts. The whole picture was indeed unique and charming, and not easily to be forgotten. That was on Saturday. The next day, in the same gay sunshine, the same gay crowds were about—the harbour, the beaches, the hills, everywhere were picnickers. Sydneyites seem to live for picnicking and

holiday making. Still, this gay and truly charming place has its drawbacks ; mosquitos are an awful nuisance, but the real bugbear is the deadly shark. Two lives have been lost within the past ten days. One of these incidents caused a great sensation owing to the unusual circumstances attending it, and the tragedy was witnessed by crowds of holiday makers on Coogee beach. What usually occurs is, an agonized shout is heard from some swimmer, a dusky form is seen, and a swirl of the great tail shows what has happened, and all is over in a few seconds. But in this particular incident a shark attacked a powerful swimmer named Coughlan, when only up to his waist in water. Coughlan hit out, striking the shark heavy blows ; still he continued his deadly darts, and in one of these he actually lept out of water and seized Coughlan by the shoulder, inflicting ghastly wounds. An eye witness told me it was a terrible sight to see the man standing up with the flesh completely torn from the arm and shoulder, and trying to defend himself with the other arm, though it, too, was torn ; the sea dyed red for yards around. All this was happening within thirty yards of the crowded beach. Men were aghast and women shrieked. A party was being organized to go to the rescue, when just then one Jack Chalmers all alone rushed in, beat off the shark and brought Coughlan in. Unfortunately, he died from his injuries shortly after being admitted to hospital. A substantial purse is being subscribed for presentation to Chalmers, and he has been recommended for the Royal Albert Medal, which he seems to well deserve.

Went to the National Gallery to-day. Modern art is well represented by Millais, Lavery, T. S. Cooper and others, but the nearest approach I could see to an "old master" was "A Spanish Beggar" "attributed to Murillo." Both here and in the Melbourne Gallery one cannot help being struck by the vigour and freshness of colour of many of the pictures. Australians do not seem to have much use for the mustiness of "old masters !" (In noting this freshness of colour, especially in the portraits, I was strongly reminded of those excellent speaking likenesses in the Lawrence Club, Lahore). But the picture which interested me most was "The Defence of Rorke's Drift," by A. de Neuville. The Rev. G. Smith is immortalized in this picture ; he is depicted in the centre, nearly life size, handing out cartridges from a bag to the soldiers. I had seen copies of the picture, but I did not know the original was in Sydney. The reason it so interested me was, because I knew his Reverence well. Years ago when I was stationed at Preston I stayed at Sumner's Hotel for a few weeks. It was a small well run hotel close to the barracks. An officer of the R.F.A. and one of the P.D. were also quartered there ; and the Rev. G. Smith lived there. He was a big hulking man with a heavy beard, and knowing sparkle in his eye—a good deal like what he is represented in the picture, though he was, of course, much younger then. We did not care much for him, as he was rather full of his importance as being the hero of Rorke's Drift ; besides, his manner was a trifle patronizing, and he rather

tried to do the "senior officer" with us, which we did not quite fall in with, as he had no official standing—still we could not well tell him to go to Heliopolis on account of his "cloth," and years (he was about 70). He had a room reserved which he kept locked; it was cram full of valuable silver, curios, and trophies of all sorts. I believe he died a few years ago without leaving any relatives—I wonder who came in for his silver and curios?

February 16: Yesterday went to the Zoo. The lions, tigers, etc., live in caves in the natural rock, and the way natural conditions of life are imitated is very perfect and interesting. In one railed off area is a half built, ordinary "life size" dwelling house, with scaffolding, hods of mortar, and everything, all in position, and swarms of monkeys scampering over the walls and scaffolding, and running here and there.

The house was, of course, purposely only half built, and the idea conveyed is that the monkeys are building it. It is very amusing and well carried out.

To-day went to Botany Bay; a great round sandy bay with a narrow entrance from the sea, ten miles from Sidney. We crossed the Bay in a motor boat to Kurnell and saw the obelisk to Captain Cook where he first landed in his boat from the ship "Endeavour" on April 28, 1770. At the opposite side of the Bay is an obelisk to La Perouse, the French navigator who landed there in March, 1788. Except to see these monuments there is nothing very interesting about the place, and the scenery is poor. It was curious Cook on his return home should have reported eulogistically on Botany Bay, which as a harbour and port is really quite useless—he completely missed the superb harbour of Sydney, though it literally was within a stone's throw of him!

(To be continued.)

Current Literature.

'Experiences with the Schick Test and Active Immunization against Diphtheria. By Drs. Copeman, O'Brien, Eagleton and Glenny. After a preliminary investigation into the value of the Schick test and active immunization against diphtheria (Copeman, 1921), the Ministry of Health instituted a more extensive test at the Mitcham Poor-Law Schools with the consent of the Guardians. In the present paper the immunological results are described.

The Mitcham schools contain a resident population of rather over 300 children between the ages of 3 and 16 years. All, until quite recently, not only lived, but received their education in one or other of the three adjoining institutions. The weekly rate of admission and discharge is small, and the population is thus a very stable one. Prior to November, 1920, these schools had been practically free from infectious disease, but since then they have been

¹ Reprinted by permission of the Editors from the *Journal of Experimental Pathology*, February, 1922.

affected with scarlet fever and diphtheria almost continuously. No case of diphtheria has, however, been notified since August 4, 1921.

The general scheme of work included a routine swabbing of all children and testing the bacilli isolated for virulence. The Schick test was applied in every case and the positives immunized with toxin-antitoxin mixtures, the effect of this being judged by Schick's method at a later date.

BACTERIOLOGICAL EXAMINATION.¹

All the children in the school and annexed infirmary, numbering 329, were swabbed on two separate occasions. The first set of swabs, hereinafter referred to as Series I, was taken eight weeks before the second set, called Series II. Children found on each occasion to be harbouring bacilli morphologically resembling *Bacillus diphtheriae* were re-swabbed until three consecutive negatives were obtained.

In all some 1,400 swabs were examined by cultural methods. The following results were obtained:—

Number of Cases diagnosed as "M.D." in Series I.

"M.D." bacilli morphologically resembling *B. diphtheriae* in smear from "Loeffler" overnight culture.

"M.D." throat only	..	..	..	..	1
"M.D." nose only	..	..	..	..	8
"M.D." nose and throat	..	..	..	..	9
Total positive	..	..	..	..	18
Total swabbed	..	..	..	..	329
Percentage positive	..	..	..	..	5.47

Cultures of *B. diphtheriae* isolated in Series I.

	"M.D." diagnosis	Cultures isolated	Sugar reactions		Virulent	Avirulent
			Correct	Not done		
Throat	1	1	1	0	1	0
Nose	8	3	1	2	2	1
Throat and nose	9	4*	3	1	2	2

* "Correct" sugar reactions were acid production in glucose, but not in saccharose. Virulence was tested by the intracutaneous method checked by the subcutaneous (Eagleton and Baxter, 1921).

* Four cultures from two patients who both harboured virulent and avirulent strains, but at different times.

Number of Cases diagnosed as "M.D." in Series II.

"M.D." throat only	..	..	..	..	1
"M.D." nose only	..	..	..	..	3
"M.D." nose and throat	..	..	..	..	2
Total positive	..	..	..	..	6
Total swabbed	..	..	..	..	327
Percentage positive	..	..	..	..	1.8

Cultures of *B. diphtheriae* isolated in Series II.

	"M.D." diagnosis	Cultures isolated	Sugar reactions		Virulent	Avirulent
			Correct	Not done		
Throat	1	0	0	0	0	0
Nose	3	2	2	0	0	2
Nose and throat	2	2	2	0	0	2

¹ The whole of the technical work was planned and carried out by the staff of the Wellcome Physiological Research Laboratories, the bacteriology being done by one of us (A. J. E.), Dr. Okell and Miss Baxter; the examination of the blood samples for antitoxin, and the control and testing of the Schick toxin and toxin-antitoxin mixtures by A. T. G. and Miss Allen; the Schick testing and the inoculations with the toxin-antitoxin mixtures by H. A. O'B.

Results of Series I and II compared.

		"M.D." diagnosis	Cultures isolated		Sugar reactions			Virulent	Avirulent
					Correct	Not done			
Series I	..	18	.. 8	..	5	.. 3	..	5	.. 3
Series II	..	6	.. 4	..	4	.. 0	..	0	.. 4
Common to both	..	3	.. 2	..	2	.. 0	..	0	.. 2
Total..	..	24	.. 12	..	9	.. 3	..	5	.. 7

The swabs in Series I were taken at the end of a series of cases of clinical diphtheria, when opportunities for infection of throats were fairly plentiful; one would naturally expect that the later series, taken at a date two months further away from the existence of manifold opportunities for infection, would show a lower reading of infection, and this is what we found.

With regard to the difficulties of isolation, one or two short notes may be made. The digestion of Loeffler's medium by organisms occurring in the throat and nose, but especially the latter, is one fruitful source of trouble. Another great difficulty consists in the fact that "M.D." may be present in very small numbers indeed. We do not think it is going too far to say that the ease with which *B. diphtheriæ* can be isolated from the nose or throat is a measure of the abundance of this organism in the nose or throat, and therefore, most probably, of the danger to the community arising from the patient under examination.

In our opinion it follows that the percentage of cases from which virulent *B. diphtheriæ* can be isolated is more important than a carrier rate based on morphological criteria, which disregard the pathogenic power of the organisms found and the number present.

In support of this view, and as a contrast to the results in these two series, the following brief account of some work that has been largely contemporaneous, and so had acted as a control, will be of interest. One hundred and fifty convalescents from clinical diphtheria were swabbed at different intervals after the disease. In fourteen "M.D." was diagnosed, and although one swab only from each case was submitted to us, from thirteen out of those fourteen virulent *B. diphtheriæ* were isolated.

In Series I five virulent carriers were found, one of them being convalescent from clinical diphtheria at the time of swabbing. The most persistent gave an initial "virulent"; subsequent cultures were "avirulent." In Series II no "virulent" carriers were found.

There had been a series of cases of clinical diphtheria in this institution, and it was to be expected that one or more carriers of virulent bacilli, easily isolated and continuously excreted, would be found. No such carrier was, however, discovered. But our examination was not made at the height of the epidemic, and we know, from general experience (cf. also Hartly and Martin, 1920), that most convalescents rapidly become clear of bacilli. It may be that one of the five "virulent" carriers (or, less probably, one of the seven "avirulent" carriers), was the cause of the epidemic, no evidence having been obtained that the infection was derived from a source outside the institution.

SCHICK TESTING.

Toxin.—The same toxin was used throughout. Fresh dilutions were made for each day's work, and the potency of the diluted toxin remaining over was tested on guinea-pigs (Glenny, Allen and O'Brien, 1921). We adopted the original Schick formula as used by Park and Zingher, 0.2 cubic centimetre containing $\frac{1}{8}$ guinea-pig M.L.D. being injected. In one group of about thirty children in which the first Schick test had given rise to some slight uncertainty, it was repeated, the original Park formula being used simultaneously with Zingher's later modification, in which twenty-five per cent more toxin is used on the left arm, and fifty per cent extra toxin in the heated control on the right arm. In

this small group of cases we could not find that the Zingher modification gave any clearer readings than the original formula.

Readings.—In a discussion of the reaction it is necessary to have concise descriptive signs or terms which should convey as much information as possible. We think this question is so important that we append a short table of explanation of the conventions that we would suggest.

SCHICK TEST NOMENCLATURE.

Type of reaction	Written description of reaction	Verbal description of reaction	Description of patient	Description previously in use
1	—	Negative	Immune = I.M.	Negative
2	— (ψ)	Negative and pseudo	Immune (pseudo reactor) = I.M.P.	Pseudo
3	+	Positive	Non-immune = N.I.M.	Positive
4	+ (ψ)	Positive and pseudo ..	Non-immune (pseudo reactor) = N.I.M.P.	Combined

The readings were made daily up to five or seven and occasionally thirteen days. If one desires to make one reading only, the most satisfactory is that made from the fourth to the seventh day after the injection.

The results of our tests are set out in Table I. The percentage of positive reactions obtained for this group of children, between the ages of 3 and 16, correspond closely with that published by Park.

TABLE I.—SCHICK TEST RESULTS AT VARIOUS AGES.

Age in years	Immune and immune (pseudo reactor)		Non-immune		Total	Per cent			
						Immune and immune (pseudo reactor)		Non-immune	
3—4	..	9	..	3	..	12	..	75.0	..
5—6	..	20	..	8	..	28	..	71.4	..
7—8	..	30	..	12	..	42	..	71.4	..
9—10	..	39	..	22	..	61	..	63.9	..
11—12	..	55	..	21	..	76	..	72.4	..
13—14	..	51	..	23	..	74	..	68.9	..
15—16	..	23	..	13	..	36	..	63.9	..
Total	..	227	..	102	..	329	..	69.0	..

Technique and reading of results.—So far as the technique is concerned, we have but little to add to the excellent description in the publications of Park and Zingher. The needle and syringe must work without any defect; the slightest bluntness of the needle or leak of the plunger at the junction of the needle results in unsatisfactory work. We used a Burroughs Wellcome No. 1 dental needle with a 1 c.c. all-glass syringe, and a 1 c.c. long tuberculin syringe; in one series a "Record" 1 c.c. syringe was used. It is most convenient to use two syringes, one for the toxin, the other for the control: these should be of the same make, with the plunger working equally well, and the needles should be equally sharp, otherwise a slight difference in the depth at which the intradermic injection is made may occur, with resultant blurring of the readings, particularly those of the first day. The control syringe may be identified by a rubber band fixed around the barrel.

Readings were made daily in most of the cases up to five or seven days, each day's reading being made without reference to the previous readings. Wherever

there was any discrepancy the Schick test was repeated. Fifty-five of the children were thus re-tested because some slight doubt or discrepancy had occurred in the course of the first test (Table II).

TABLE II.—“DOUBTFUL”. SCHICK RESULTS AMONG 329 CHILDREN TESTED.

First Schick test			Second Schick test	
Readings regarded as probably:—				
— & — (ψ)	+ & + (ψ)		— & — (ψ)	+ & + (ψ)
44	11		44	7
			4	
Total	44	11 = 55	48	7 = 55

Consideration of these cases shows that when a reading is doubtful, it proves on further investigation, in the great majority of cases, to be negative or “negative (and pseudo).” When deciding that a given reaction is “negative (and pseudo),” one has always present in one’s mind a slight fear that the reaction may be “positive (and pseudo).” Fortunately these latter reactions are rare. Of the 329 children only two showed a “positive (and pseudo)” reaction, i.e., on the right arm a reaction which, although smaller, resembled the left in depth of colour and degree of desquamation.

Table III gives details of the four cases in Table II in which differences were obtained on re-testing.

TABLE III.—APPARENT DISCREPANCIES.

First test		Second test		Blood sample
(1) Positive (and pseudo)	..	Negative (and pseudo)	..	More than $\frac{1}{10}$ unit of
(2) Positive	..	Negative (and pseudo)	..	antitoxin per cent of
(3) Positive	..	Negative (and pseudo)	..	blood found in every
(4) Positive (and pseudo)	..	Negative (and pseudo)	..	case

On referring to the readings we had recorded in the first test, we found in every case that the final entry, on which the child was classed, recorded a “very faint” or “very, very faint” stain on the left arm, greater in size than on the right, and that some of the readings had suggested a “negative (and pseudo)” reading. With the experience gained in these cases and the help supplied towards the interpretation of doubtful readings by the determination of antitoxin in the patient’s blood, we should, with similar readings now, return the case as “immune (pseudo reactor).”

Blood Samples.—Our confidence in the ultimate accuracy of our classification of the children as immune or non-immune is founded partly on the results of the repeated Schick tests in “doubtful” or difficult cases, but to a greater extent on the interpretation of the titration of antitoxin in the blood of individual children by the Romer method (Glenny and Allen, 1921). This we regard as a very important part of our investigation.

TABLE IV.

Antitoxin per c.c. of blood	Number of cases		
5–20 units	7	} Eight of these children had had toxin-antitoxin mixtures injected
2–5 „	8	
1–2 „	15	
$\frac{1}{2}$ –1 unit	9	
$\frac{1}{3}$ – $\frac{1}{2}$ „	9	
$\frac{1}{10}$ – $\frac{1}{5}$ „	5	
?– $\frac{1}{1000}$ „	5 ¹	
Less than $\frac{1}{2000}$ unit	8	

Note.—In many instances the sample of blood for titration of antitoxin was not taken until approximately a week after the Schick test was done.

¹ All of these five sera, when injected intradermally without toxin into guinea-pigs, gave some reaction; it was, therefore, difficult to estimate the antitoxin content with the small amounts of serum available.

Many observers state that an antitoxin content per cubic centimetre of blood of less than $\frac{1}{80}$ unit of antitoxin will fail to neutralize the toxin injected in the Schick test and so make the readings positive, while, with a greater antitoxin content, a negative Schick reaction will result. Our own experience in several hundred tests had hitherto afforded no ground for disagreement with this statement.

Sixty-six blood samples were taken and the antitoxin titrated. The findings are shown in Table IV.

Recent experiments on animals (yet to be published) show that the minute amount of toxin used in the Schick test is sufficient, under certain circumstances, to cause the development of such a degree of immunity that an animal which has just given a non-immune Schick positive result will a week or two later, when the test is repeated, give an immune negative response. This may possibly be the explanation of some of the discrepancies recorded.

It is probable that these results will be confirmed on the human subject, but the point will be dealt in a subsequent paper.

Error on First Day's Reading.—It is obviously of great importance in the presence of an epidemic of diphtheria to be able, if possible, to make a decision that the given patient is immune or not within the first twenty-four hours of the Schick test. We did in all approximately 400 Schick tests. In four instances the first day's reading was entered as "negative," whereas later readings showed that the reaction was "positive." First day's readings of the reaction in eight children were "positive," but the later readings showed clearly that the reaction was "negative" and the children therefore immune. In nine instances the first day's reading entered as "doubtfully" positive or negative differed from the final reading. Thus an actual error was made in twelve cases and a dubious but erroneous reading in nine, i.e., twenty-one in all. In 400 tests, therefore, a decision based on the first day's reading proved erroneous in five per cent of the cases.

"Carriers."—The following table gives the results of the Schick test and examinations of the blood of children who harboured "morphological diphtheria bacilli." It is to be noted that the carriers of virulent bacilli possessed a fairly high degree of immunity.

TABLE V.

	Virulent cultures isolated	Avirulent cultures isolated	"Hoffmann" isolated	"M.D." not isolated
	5	7	4	6
Schick test positive..	0	1	2	1
Schick test negative	5	6	2	5
Blood samples examined	5	1	—	3
Antitoxin content per c.c.	4, 1 unit 1, $1\frac{1}{2}$ unit ¹	< $\frac{1}{1000}$	..	1 < $\frac{1}{1000}$ 2 $\frac{1}{2}$ —1 3 2—5

Note.—In some of these instances the sample of blood for titration of antitoxin was not taken until approximately a week after the Schick test was done.

ACTIVE IMMUNIZATION.

All children giving a positive Schick reaction, 102 in all, were given three weekly doses of one cubic centimetre of toxin-antitoxin mixture (Park-Zingher formula and American official standard). As a precautionary measure, in most cases a preliminary injection of 0.05 cubic centimetre had been given.

Reactions.—The results were reassuring. Of the 102 children, 17 were reported to the nurse (one child twice); 8 had a temperature of 102°, 4 of 101°, and 2 of 99° F. Though this number (seventeen) seems large, the reaction was so slight in all but three of the children that they did not wish to stay in

¹ Patient G. M. referred to under "Results of Immunization" (p. 7).

bed for the whole day. One of the remaining three wished to stop in bed for two days.

W.G., one of the two that were ill, had a temperature of 102° F., and was distinctly ill for three days after her first dose of 0.05 cubic centimetre. A week later she received 0.01 cubic centimetre, and at intervals of five days 0.05 cubic centimetre, 1 cubic centimetre, 1 cubic centimetre, 1 cubic centimetre. She remained quite well throughout.

It is therefore probable that the initial illness was due to some other cause than the injection of the mixture.

The other child, A.B., vomited immediately after the first injection, and was ill for two days. Inquiry showed that she had had a pork dinner a few hours before the injection, and had suffered from abdominal pain before the injection. Unfortunately this was not known to us.

The constitutional reactions were slight. Local reactions, on the other hand, were at first alarming. In approximately half of the cases a large flushed area varying from 2 inches by 1 inch to even 6 inches by 3 inches appeared, but rapidly cleared up after the first twenty-four to forty-eight hours. We were very disturbed until we learned by experience that a large angry-looking swelling would not prevent a boy from playing football two days later, or a girl from skipping on the first day after the injection, and that it did not interfere to any great extent with sleep.

Results of Immunization.—Approximately eleven weeks after the conclusion of the course of immunization the whole of the children in the school were again subjected to the Schick test.

Of the 227 children who had been classified by the first Schick test as immune, 203 remained in the school; of these, 201 again gave negative or negative (and pseudo) reactions, while two children showed positive reactions. Samples of blood were obtained from these two, and neither contained any antitoxin. Both children had had diphtheria and had been removed to hospital, where they were given antitoxin shortly before the first Schick test was done. It appears probable that the first Schick test, which in one child was undoubtedly negative, and in the other (G. M.) had been read as "pseudo (with a faint possibility of positive)," had been influenced by some remnants of the antitoxic serum which had been injected in hospital. Before the second Schick test was performed, some three months later, the last remnants of the horse antitoxic serum had been excreted, and the Schick results were therefore positive.

Of the 102 children who had given a positive reaction, and had been inoculated with a toxin-antitoxin mixture, ninety-nine remained and were retested. Two still gave a clear positive reaction; samples of their blood were tested; no antitoxin was present in either. These children will be reinoculated.

CONCLUSIONS.

(1) In a residential school of 329 children, amongst whom a recent epidemic of diphtheria had occurred, 18 (6 per cent) carried morphological *B. diphtherie* in throat or nose. At the first swabbing, at the end of the epidemic, five per cent of carriers were found; at the second two months later, two per cent. From these 18 children 12 cultures were isolated, of which 5 were virulent.

(2) The later swabbings from these five carriers showed either avirulent organisms or no "morphological diphtheria" bacilli.

(3) On the grounds of a bacteriological examination of a large number of cases of diphtheria, carriers and convalescents, the following suggestions are tentatively put forward:—

- (i) That the "avirulent carrier" is of no importance epidemiologically.
- (ii) That the danger of a carrier of virulent bacilli is, at the time of examination, proportionate to the number of virulent bacilli present in throat and nose, and, therefore, to the ease with which the virulent bacilli can be isolated.

(4) Of 329 children, aged from 3 to 16, 102, i.e., 31 per cent, gave a positive Schick reaction; 95 per cent of the readings made on the first day proved to be accurate.

Of the 227 children who had given a negative response when first Schick tested, 203 remained in the school eleven weeks later. Of these, 201 on being re-tested again gave a negative or a negative (and pseudo) response, thus confirming the decision made two months previously. Two showed a positive response at the second test; these two children had had antitoxin injections shortly before the first test was made.

(5) These 102 children were inoculated with toxin-antitoxin mixtures (Park and Zingher formula). Local reactions occurred in about one-third of the children; though in some of these the area of inflammation was large, the activities of the children were but little interfered with. Constitutional reactions were slight in all but two of the children.

(6) Of the 102 children, ninety-one were still present in the school eleven weeks when the Schick test was repeated. Two gave an undoubtedly positive response, the remainder a negative or negative (and pseudo) reaction; ninety-eight per cent were therefore immune.

We have much pleasure in thanking Dr. Mandy for interesting the Guardians in the test, and Dr. Morrish, the Medical Officer; Mr. Drury, the Superintendent of the schools; Mrs. Drury, the Matron, and the Infirmary Sister, for the valuable assistance afforded by them, especially in arranging practical details in connexion with the work.

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Reviews.

MEDICAL SERVICES DURING THE WAR. DISEASES OF THE WAR.

THE second of the series of volumes of the Medical History of the Great War, which are being prepared under the general Editorship of Major-General Sir W. G. Macpherson, K.C.M.G., C.B., is now available to the public and may be purchased through any bookseller from His Majesty's Stationery Office. The present volume, which is the first of two volumes on Diseases, consists of a series of chapters on various diseases, contributed by consulting physicians who during the war held Regular, Territorial Force or Temporary Commissions in the Army Medical Service, and had special knowledge and personal experience of the diseases on which they have written. The contributors include Dr. Andrew Balfour, C.B., C.M.G., President of the Advisory Committee, East Mediterranean, 1915-1916; Sir John Rose Bradford, K.C.M.G., C.B., Consulting Physician, B.E.F. France; Right Hon. Lord Dawson of Penn, Consulting Physician, B.E.F. France; Dr. Michael G. Foster, Consulting Physician to troops in France and Flanders; Dr. Herbert French, Consulting Physician, Queen Alexandra Military

Hospital; Sir Wilmot P. Herringham, Consulting Physician, B.E.F., France, 1914-1919; Dr. William Hunter, C.B., Consulting Physician, Eastern Command; Lieutenant-Colonel P. S. Lelean, C.B., Professor of Military Hygiene, R.A.M.C., A.D.M.S. (Sanitation), Egypt; Dr. P. H. Manson-Bahr, D.S.O., officer in charge of Malaria Diagnosis Stations and Military Laboratories, Egyptian Expeditionary Force; Dr. J. A. Torrens, F.R.C.P., Specialist on Enteric group of fevers, and Sir W. H. Willcox, Consulting Physician to Forces in Mesopotamia.

The various diseases have been dealt with in this volume merely from the clinical point of view, though it has been considered desirable to introduce some detail in regard to preventive treatment and pathology, both in this and in the succeeding volume on Diseases. Separate volumes on Hygiene and Pathology during the War will deal with the diseases from the hygienic and bacteriological standpoints. But in regard to incidence of diseases during the war, the facts that were learned from observation clinically, and the results of treatment, the present volume furnishes information which has rarely, if ever, been previously compiled in an official history dealing with diseases of war. The editors admit that in this volume there is some repetition, notably in the chapters on influenza and purulent bronchitis, consequent upon these diseases having been considered from two separate standpoints, namely the experience of the epidemic amongst our forces in France and the experience of the epidemic in the United Kingdom. On the other hand this two-fold series of experiences gives a wider scope for comparing the results of observation and of treatment.

In the chapter on Influenza (contributed by Dr. Herbert French and Sir Wilmot Herringham) a large amount of information on symptoms has been collected and much attention has been paid to the all-important question as to the conditions under which pneumonic complications would develop.

"Delirium and coma occurred in bad cases, but more striking was the number of cases in which they were absent. Big, strong men, cyanotic, breathing thirty to the minute and obviously dying, would be fully conscious and would talk rationally, not realizing their danger in the least, to within half an hour of death."

It is at least a little re-assuring in the light of the above quotation to find that the authors agree that :—

"It is important to emphasize the fact that these fatal 'pneumonic' cases contributed but a minority of the whole. There were far more cases of ordinary typical benign influenza than there were of 'influenzal pneumonia.' Broadly speaking, out of 1,000 individuals stricken by the disease fully 800 had no more than an ordinary attack of uncomplicated 'influenza,' a little more severe perhaps than the 'three-day fever,' of June, 1918, but not any worse than simple influenza as it may occur at any other time. In the remaining 200, 'pneumonic' symptoms were added to those of simple influenza, and of those about eighty died. The most ominous symptom was the heliotrope cyanosis. It developed in less than half the pulmonary cases, but once it became definite the prognosis was so bad that out of every 100 blue cases about ninety-five died."

The chapter on Cerebrospinal Fever is valuable, both on its symptomatic and on its prophylactic side, and especially as showing the exceptionally favourable results of the course of treatment which was developed from the experiences of this disease during the war. It is curious that the disease has not characterized any war prior to 1914. In previous campaigns, with the exception of outbreaks in French garrisons during the Napoleonic Wars and an epidemic in the Army of the Potomac in the American Civil War, the disease, we are told by the writers, has been singularly absent, but during the War 1914-1918 the disease was epidemic in a formidable manner amongst the troops in the United Kingdom, while a concurrent epidemic raged amongst the civilian population. Serum treatment employed in the outbreak of the disease in 1914 seems to have been disappointing; for amongst the Canadians (who would seem to have imported the disease from their own country) there were 40 cases with no fewer than 26

deaths, a mortality of 65 per cent. War experience, however, taught the authorities a great deal about the danger from carriers, for of course there was much inevitable overcrowding during mobilization. Acting on this assumption, seemingly well-founded, that cerebrospinal fever "is largely caused by overcrowding," the authorities come to the conclusion that the first essential preventive measure is the strict observance of a few hygienic rules.

The chapters on Malaria and Dysentery must impress everyone and especially military commanders with the losses which these diseases may cause to a force in the field. On the other hand the account of the incidence of enteric fever shows what enormous progress has been made in the prevention of this disease since the South African War, and the consequent saving of life and man-power.

There is again much that is arresting in the chapter on Trench Fever, contributed by Brevet Lieutenant-Colonel Byam and Sir Wilmot Herringham, who admit that no remedy has been found that will cure the disease, and that the so-called "good effects" from treatment with quinine, arsenic, salvarsan, etc., were not corroborated.

"Experience shows that in order to return men to duty as soon as possible the surest course is to treat the disease seriously, to admit the patient to hospital at the earliest possible date . . ." and it is surely eloquent of the lives that the soldiers led to find it stated:—

"The preventive treatment consists in freeing the men as far as possible from lice."

The second volume on Diseases will be concerned chiefly with gas warfare, the medical aspects of aviation, and mine warfare; and will, in addition, consider from a military standpoint various nervous disorders, skin diseases and venereal disease. Either this second volume on Diseases, or the two volumes on Surgery will be the next to appear, and then will probably follow at no great interval the two volumes on Hygiene. It is believed that the whole series, excepting the two volumes on Statistics and Epidemiology, will be completed by about the end of the year, with the exception of the General Histories of Medical Services in the Various Campaigns of the War, the first volume of which has already been published. The remaining volumes are in course of preparation, but in compiling them the Editor-in-Chief has to deal with a vast amount of documents which require a considerable time to digest.

THE MECHANISM OF THE BRAIN AND THE FUNCTION OF THE FRONTAL LOBES.
By Professor Leonardo Bianchi. Edinburgh: E. and S. Livingstone, 1923.
Pp. 348. Price 21s. net.

The problem of the functions of the frontal lobes and the relation of these functions to those of the brain as a whole has provided material for an old-standing controversy to which Professor Bianchi of Naples has for many years contributed. In the volume before us he brings to a focus his long experience in experimental and psychological inquiry. His conclusions regarding cerebral function are difficult to summarize in a manner such as to do justice to his work. He holds strongly that the higher consciousness which is the special attribute of man, and to a less extent of the higher mammals, is mediated by the anterior portions of the frontal lobes, especially of the left. The relative development of this part of the brain increases with the evolution of the intelligence as exemplified by such attributes as character, attentiveness, perception, memory, and so on. The large areas of the cerebral cortex situated behind the frontal area constitute the sensory region. Here are situated indispensable workshops of mind, but these are comparatively poorly endowed with consciousness. Eliminate the activities of the frontal region and an inferior grade of consciousness remains which approximates in some measure to that of the imbecile. The symptoms akin to dementia which result from a left frontal lesion contrast strongly with the anxious consciousness

of disaster often seen in those subject to even severe lesions of the posterior areas of the cerebral mantle which abolish speech and coherent thought.

The view of the cerebral functions here outlined by the author is by no means the only one in the field. Flechsig's view that the parietal association area has as high a mental function as the frontal area is well known; indeed some of the views that have been held almost seem to leave the frontal lobes without any functions at all. General opinion, however, now seems to favour Bianchi's opinions.

The author's views of the significance of the excitable portion of the frontal cortex and also of the representation of the viscera in the cortex are well worth reading.

In the concluding portions of the book such questions as the nature of intelligence, language, logic, emotion, social sentiment, and consciousness are discussed. The book does not profess to deal with the clinical aspect of cerebral specialization except incidentally.

This account of Bianchi's masterly and laborious researches is of the greatest interest and English readers will welcome Dr. MacDonald's excellent translation. The book is very well printed and got up. H. G.

THE SURGICAL EXPOSURE OF THE DEEP-SEATED BLOOD-VESSELS. By J. Fiolle, M.D., and J. Delmas, M.D. With thirty-four original illustrations by H. Beaufort. Translated and Edited by Charles Greene Cumston, B.S.M., M.D. (Geneva). London: William Heinemann, Ltd., 1921. Pp. 87. Thirty-four illustrations. Price 8s. 6d.

This book is the outcome of experience gained during the Great War.

It was no uncommon experience during the late war to see skilful surgeons entirely at fault when dealing with a large arterial hæmatoma, the result of injury to a deep vessel. They failed to realize that a bold type of surgery with extensive incisions and if necessary section of muscles and bones was the safest method for the patient.

Since the war the instruction at the Royal Army Medical College has been advocating this departure from the old classical lines laid down in text-books.

This original book describes the routes and methods of freely exposing the deep vessels in a thorough and masterly manner, but emphasizes the importance of planning the operation in such a way that reconstruction of the tissues with complete restoration of function should always be possible.

An essential feature of the technique is the planning of the extensive incisions so that the enervation of muscles is strictly preserved.

We are in entire agreement with all the methods advocated, the least convincing being the exposure of the superficial femoral at its passage under the adductor arch.

The illustrations, which are all original, are good and serve to elucidate the text satisfactorily.

The translation is exceptionally well done, and although occasional unfamiliar words are used the meaning is always clear.

The work is produced in the publisher's usual high-class manner.

While the main value of this work is for military surgeons, yet, in civil surgery there are times when reference to the methods advocated in this book will be very valuable.

A STUDY OF INTESTINAL STASIS. By Dr. J. C. Watt, M.C. London: John Bale, Sons and Danielsson, Ltd. 1922. Pp. 23. Price 1s. net.

In the course of a speculative pamphlet, the author advances the view that constipation is a disease invariably acquired in infancy, and that in acquiring control over the rectum the infant is really developing a pathological condition of

the intestine. The presence of any organism of any kind in the *fæces* marks, for the author, the commencement of a pathological condition of the bowel. Scarcely less sweeping is the assertion that all intestinal stasis commences as a primary and unexplained "pelvi-rectal spasm," to which in later life such diseases as appendicitis, cholelithiasis, and malignant disease of the bowel and stomach are directly attributable. The author would cure all evils of intestinal stasis by an operation on the sigmoid colon, details of which are given.

It is unsafe to generalize, within the compass of a short essay, on a complex subject of great magnitude. As has been stated, the pamphlet is speculative, and as such cannot be considered a very serious contribution to our knowledge of the subject.

J. H. S.

TEN POST-GRADUATE LECTURES DELIVERED BEFORE THE FELLOWSHIP OF MEDICINE AT THE HOUSE OF THE ROYAL SOCIETY OF MEDICINE, 1919-1920. With a Preface by the Right Hon. Sir Clifford Allbutt, P.C., K.C.B., M.D., F.R.S. London: John Bale, Sons and Danielsson, Ltd. 1922. xvi + 216. Price 10s. 6d. net.

The lectures collected in this volume are as follows: Syphilis and Insanity, by Sir George H. Savage. The Prognosis of Exophthalmic Goitre, by Sir William Hale-White. Grave Familial Jaundice of the Newly Born, by Sir Humphry Rolleston. The Value of Combined Treatment, with Special Reference to Surgery, Electricity and X-Rays, by Francis Hernaman Johnson, M.D. On the After-effects and so-called After-effects of Anæsthetics, by J. D. Mortimer, M.B., F.R.C.S. Chronic Paroxysmal Trigeminal Neuralgia and its Treatment, by Wilfred Harris, M.D., F.R.C.P. Morbid Mental Growths, by Sir George H. Savage. Pyorrhœa Alveolaris and its Relationship to Disease, by N. Mutch, M.D., F.R.C.P. Disabilities of the Feet due to Static or Mechanical Causes, by W. H. Trethowan, M.B., B.S., F.R.C.S. Deformities and Disabilities of the Feet due to Paralysis, by W. H. Trethowan, M.B., B.S., F.R.C.S.

The preface by Sir Clifford Allbutt is in itself a brief and commendatory review on each lecture and concludes thus: "Such lectures as these, reinforced by the personal influence of the teachers, must be a godsend to graduates who wish to keep abreast of the medicine and surgery of the day; especially if illuminated, as no doubt they were, by clinical demonstrations. The Fellowship of Medicine is to be congratulated on so eminent a part of its still more extensive labours."

J. C. K.

THE PRINCIPLES OF PREVENTIVE MEDICINE. By R. T. Hewlett and A. T. Nankivell. 8vo. Pp. viii and 536, with 12 charts and 5 diagrams. J. and A. Churchill. 1921. Price 18s.

This book presents a comprehensive outline of the principles and practice of preventive medicine as far as it concerns the medical student and general practitioner and we would also commend the earlier chapters on Mother and Child Welfare and the health of school children and adolescents, not only to these but to parents, nurses, district visitors, school teachers and others.

The book is admirably written and well printed. The subject matter covers a wide range and is dealt with in a broad and sympathetic manner which makes it one of the most easily readable books on public health that we have met with. It is moreover well up-to-date.

The sections on infectious diseases, inoculation and immunity are essentially concise and practical, though, in speaking of carriers of the Klebs-Löffler bacillus no mention is made of the varying virulence or even non-virulence of certain strains that may be found in examining contacts of diphtheria cases, and the council of perfection that all carriers of this organism be removed to an isolation hospital (p. 363) till they cease to be carriers, a process which may take many months, is a point which might be modified.

In dealing with industrial hygiene some of the principal health enactments in Sanitary Law are clearly enumerated and incorporated in the text, a method which for a volume containing a general view of so wide a subject is one wholly to be commended.

The chapter on statistical methods and vital statistics gives a brief résumé of the subject without going too deeply into mathematical details and points out elementary principles and common pitfalls in a difficult and specialized subject.

Appendices on Notifiable Disease and Notification and on Death Certificates bring the volume to an end, the whole of which is well and carefully indexed.

The price brings it within the reach of the average purse and we hope that the book will receive the widespread distribution and acknowledgment that it deserves.

A. S. C.

Correspondence.

PROPHYLAXIS OF MALARIA IN 1817.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—While staying in a country house recently I came across an old volume of the *Journal of the United Services* and transcribe some observations on malaria which may prove interesting to your readers.

The article is by Professor Thomas Traill, and the date 1837.

"The proposal to defend the body against marsh miasma by the interposition of gauze-net was first made by Rigaud de l'Isle in the 'Mémoires de l'Institut for 1817.' He there asserts that the miasms causing intermittent fevers are denser than common air, and may be separated from it by this mechanical species of filtering. Brocchi has taken up the same idea, and he avers that he has successfully employed a fine gauze mosquito net in counteracting the effects of malaria."

I am, &c.,

E. KENNETH CAMPBELL,

Major, R.A.M.C. (T.C.).

Notices.

EDITORIAL NOTICES.

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Original Communications.

THE ACTION OF CHLORINATED WATER ON GALVANIZED-IRON TANKS.

BY BREVET MAJOR N. V. LOTHIAN, M.C., AND CAPTAIN A. R. WARD, R.A.M.C.
Army School of Hygiene.

(1) INTRODUCTORY.

DURING the war many complaints were heard as to the "chemist's shop" flavour of chlorinated waters, even where the greatest care was taken to avoid excessive chlorination. Various attempts have been made to "explain" this flavour, but no generally satisfactory reason appears to us to meet all cases. The experimental work detailed in this report was carried out to elucidate how far the containing receptacle was at fault, and, in our opinion, points strongly to its culpability when it is of the common galvanized-iron type. It will be recalled that many of the water carts, and the vast majority of the larger "water-point" tanks and smaller regimental tanks were zinc-lined. In our experiments here summarized, small galvanized-iron tanks which had not previously contained chlorinated water, and which were virtually new, were used throughout.

(2) THE ZINC-SOLVENCY OF RAW WATERS.

Traces of zinc may occasionally be detected in natural raw waters; but the zinc content of a potable supply is as a rule derived from the zinc coating of pipes, cisterns, cooking utensils and cups; it is a more prevalent element than is commonly realized and varies in amount with the hardness of the water (inversely) and the period of contact with the containing zinc walls.

The latter appear to oxidize slowly on the surface, and while the thin film so formed is virtually insoluble in ordinary waters, it is readily taken

up by soft, and also by salty waters whose solvency-power is directly related to the chlorides present—vide the argument and data in Blyth's "Poisons." Calcium carbonate greatly reduces this solvent-power, and Thresh ("Examination of Water and Water Supplies") points out that zinc is usually to be found in soft waters having less than three to four parts of temporary hardness (calcium carbonate) per hundred thousand. The importance of noting the reaction of raw waters is thus evident, free carbonic acid, in excess of that required to convert carbonates to bicarbonates, being the factor which makes it possible for the water to react on the zinc and form the carbonate.

During the war it was observed that some of the waters in France contained appreciable quantities of zinc derived from galvanized-iron pipes and tanks, and analyses at the Base Hygiene Laboratory showed, for example, that the water from six large tanks in Boulogne averaged 0.18 grain of zinc per gallon, and in one tank reached 0.28 grain per gallon.

(3) EXPERIMENTAL DATA WITH RAW WATERS.

Most observers have noted that the amount of zinc found in waters acting on galvanized-iron containers depends chiefly upon the length of contact with the metal. At Etaples, for instance, a controlled water supply showing 0.10 grain per gallon was found to have, after one day in a zinc tank, 0.35 grain per gallon, after two days 0.42 grain per gallon and so on at a gradually diminished rate. Our results were as follows:—

	Grains zinc per gallon	i.e.,	Parts per million	After storage of
(a) With a first filling of raw water in a new tank	0.28	..	4	18 hours
(b) On a second filling	0.17	..	2.5	18 hours
i.e., with raw water there is a mild corrosive action, diminishing, however after the initial fillings.				

(4) CORROSIVE EFFECTS OF CHLORINATED WATER.

The only previous figures we can trace are some analyses made on water from Rouen which had been so chlorinated as to receive one part per million of available chlorine. After some time (?) in zinc tanks this water was found to contain zinc to the extent of 0.35 grain per gallon. We have made a very large number of analyses of waters retained in tanks for varying periods after chlorination, and have varied both the vehicle and method of administration of the chlorine to eliminate fallacies. In brief, it may be said that such waters have a very much more intense corrosive action on the zinc lining, the extent varying with the period of storage, but being in any case more active when the tank is new (as with raw waters).

Thus (average of many analyses):—

	Grains zinc per gallon	i.e.,	Parts per million	After storage of
(c) On first filling a new tank with chlorinated water	1.4	..	20	24 hours
	2.1	..	30	48 "
	3.5	..	50	72 "

On later fillings the amount of zinc found declined progressively with each filling until after some three weeks the amount found represented only about one-tenth of that to be found in a new tank; presumably a protective layer of zinc oxide is formed (? zinc carbonate as well) thus:—

(d)	Grains zinc per gallon	i.e.,	Parts per million	After storage of
On filling a tank used for three weeks with chlorinated water	0.14	..	2	24 hours
	0.21	..	3	48 "
	0.35	..	5	72 "

The most violent action is thus apparently to be expected when tanks are new. It was interesting to find, however, that once the process of active corrosion in a fairly new tank has been started by the use of chlorinated water, even raw waters will continue the action at a rate much more rapid than would be expected. Presumably electrolytic action has been set up, and accounts for results such as the following:—

(e)	Grains zinc per gallon	i.e.,	Parts per million	After storage of
On filling a fairly new tank previously corroded by chlorinated water with plain tap water only	0.17	..	2.5	4 hours
	1.4	..	20	24 "

There appears to be no definite relationship between the proportion of chlorine added and the corrosive action which results; ordinary proportions such as one part per million available chlorine being quite sufficient to produce marked results, irrespective of whether given by bleaching powder, chlorine gas, or chlorine water. The chief point to note is the intense corrosive action on the zinc lining, of chlorinated waters.

(5) CHANGES IN REACTION, AND RELATION TO ZINC SOLVENCY.

So long as "free" chlorine can be detected in the water the amount of zinc is not appreciable. With the disappearance of free chlorine there is definite increase both of zinc and of alkalinity. Until it reaches a concentration of six parts per million (0.42 grain per gallon) the zinc remains in solution; between six and ten parts per million (0.42 to 0.7 grain per gallon) turbidity appears; at and above the latter quantity it is precipitated as a dirty grey flocculent deposit of hydrate, with traces of the carbonate.

The changes in reaction were carefully noted and it was found that precipitation of the zinc hydrate usually commenced when the hydrogen-ion concentration was, in Sørensen's notation, $\text{PH } 7.8$. The course of these changes was as follows:—

(f) By titrating with methyl orange (sensitive to total carbonates), the alkalinity appeared to remain constant till the zinc entered into solution, whereafter it increased slightly.

(g) By estimating the hydrogen-ion concentration, however, it was found that

- (i) On the addition of bleaching powder (containing free $\text{Ca}(\text{OH})_2$, to which phenol red is sensitive), there is increased alkalinity.
- (ii) With the liberation of chlorine on standing, the alkalinity diminishes to a constant, by reason of the change of free lime

into the bicarbonate; the latter is insensitive to phenol red, and this outweighs the loss of the acid chlorine radicle.

(The process can be demonstrated by the addition to freshly-boiled distilled water of some lime-water, giving a resultant water of PH 7.8 to 8.0; on shaking this up atmospheric CO_2 is absorbed and the addition of an indicator such as phenol red gives ocular demonstration of the rapid decrease of the PH value to the standard of distilled water — approx. 7.0.)

- (iii) Finally, the alkalinity again increases by reason of the entry into solution of the zinc, and the formation of $\text{Zn}(\text{OH})_2$.

We are therefore inclined to regard the hydrogen-ion concentration of the water as of first interest. Mere increase of the alkalinity (as ordinarily understood) does not appear to hinder the zinc-solvent action at all, as is evident from the following figures. In these tests, conducted out of doors to avoid absorption of laboratory ammonia, and in new tanks, plain tap water only was used; the results were:—

	After storage of	Grains zinc per gallon	i.e., Parts per million	P _H	Alkalinity (as CaCO_3) to methyl orange
(h) Tank with plain water ..	(at once)	—	—	6.85	5.6
	6 hours	0.27	3.9	7.1	6.2
	24 "	0.37	5.3	7.5	8.4
	72 "	0.95	13.6	7.6	13.6*
(i) Tank with plain water plus 2 parts per million CaO	(at once)	—	—	7.8	7.0
	6 hours	0.33	4.8	7.7	7.6
	24 "	0.44	6.3	7.8	9.1
	72 "	1.42	20.4	7.8	16.8

* It will be noted how the alkalinity increases with the zinc.

(6) THE EFFECTS OF ZINC ON THE BODY.

Toxic effects from zinc are usually confined to the use of the sulphate, an irritant poison in doses of about one ounce (v. Mackintosh, *British Medical Journal*, 1900), and of the chloride, a corrosive poison. Among workers in brass and zinc foundries, however, a number of disabilities have been ascribed to the inhalation of zinc dust and fumes, although arsenic has not been conclusively excluded, nor protein absorption from the seared and necrosed epithelial lining of the respiratory tract. According to Harnack the essential action of zinc salts is a paralysis of the musculature, affecting vitally the heart and respiration; and the lethal dose (tested on rabbits) is 0.04 gramme of zinc oxide per kilogram of body weight. As regards those salts found more commonly in the weak concentration of zinc-solvent waters, the oxide, hydrate and carbonate, there is no clear evidence. Blyth ("Poisons") regards zinc oxide as "so weak that it is almost doubtful whether it should be considered a poison," while large doses have been given in epilepsy, and Thresh quotes numerous cases of zinc-containing waters taken without harmful results over long periods. In France, where some half grain per gallon was the highest amount recorded, tank waters were in constant use for months, and no ill-effects whatever were observed among the men drinking them.

On the other hand, a number of cases of illness have been attributed to zinc waters; thus zinc oxide was blamed by Spillmann (*Rev. Med. de l'Est*, 1883) in a case of fatal illness, the patient using galvanized cooking vessels only, and large amounts of zinc being found in the cadaver. Again, at an inquest in New Zealand in 1907, the jury found that the deceased had died from drinking water collected from a zinc-iron roof in a galvanized tank; the Government analyst estimated the body to contain over sixteen grains of metallic zinc, and showed the water to have an unusually high zinc content (Case quoted by Glaister, "Med. Jurispr."). Gimlette (*British Medical Journal*, 1901) reported an epidemic of zinc poisoning among Sikh soldiers in Malaysia, the circumstances being similar to the above case in New Zealand, and the symptoms mainly dysenteric and nervous. In this outbreak (which, however, reads as though food-poisoning perhaps played a part) the roof water contained 0.78 grain per gallon, but the tank water less, by reason of the liberation of CO_2 in the tank throwing down the carbonate as oxide. Similar outbreaks have been reported near Llanethly, with a zinc content of over fifteen times the last quoted (*Lancet*, July, 1893) and elsewhere (v. *Lancet*, 1896 and 1897).

The toxicity of these zinc salts may thus be regarded as doubtful, but in any case their prolonged ingestion can do little good, however harmless in small individual doses. We agree entirely with Thresh that "zinc is not a desirable constituent of a potable water," and come accordingly to the means of eliminating it from the supply. Where possible, of course, soft zinc-solvent waters should be avoided: but this may be impracticable.

(7) GETTING RID OF THE ZINC.

Where waters with a zinc-solvent action have to be stored in galvanized tanks, it is obvious that the shorter the period of storage the better. When run through zinc pipes, the water which has stood for any length of time should be run off to waste. But in any case such pipes appear to become coated in time with an inactive deposit in similar fashion to lead pipes. The process can be hastened by the addition of large quantities of chalk to the freshets supplying the reservoir whence the zinc pipes carry the water to the consumer. This practice, dependent on the formation of a crust of insoluble zinc carbonate, was successfully employed in France.

Where the water takes up the zinc from storage tanks, the only possible method appears to us to be to line the walls with a coating of some material which will not permit interaction between the walls and the contained water, especially when the latter is the more intensely zinc-solvent chlorinated water.

(i) Experiments with *lime-washed* tanks were satisfactory in that zinc-solvency was prevented, but the coating of lime very easily brushes off (e.g., in cleaning water-carts) and has only a short effective life. There is, of course, marked increase in alkalinity, amounting to over 100 parts per million of CaO after one hour's storage, but with repeated fillings this excess falls off, and is minimal after some eight fillings. The following figures typify the results of analyses of waters from such a "mature"

168 *Action of Chlorinated Water on Galvanized-Iron Tanks*

lime-washed tank, the water employed being tap water of alkalinity (CaCO_3) 10.0, and PH 6.85, viz. :—

(j)	After storage of	Zinc	PH	Alkalinity (as CaCO_3)	Free chlorine
Water with addition of 1 part per million free chlorine as chlorine water	$\frac{1}{2}$ hour	Nil	6.65	10.0	0.5
	$\frac{3}{4}$ "	"	6.65	10.0	0.15
	$1\frac{1}{2}$ hours	"	6.75	10.0	Nil
	2 "	"	6.85	11.25	"
	24 "	" over 8.00	—	—	"

(ii) *Cement-washed* tanks are as effective in preventing corrosion of the zinc walls as lime-washed, but this method of protection is not advised. The cement takes two to three weeks to set properly, and is easily damaged in cleaning, and in extremes of heat or cold.

(iii) A more stable lining of inert material being desirable, attention was given to some *bituminous preparation* such as is employed in Canada. Such preparations were used to a fair extent during the war, usually in the form of bitumen with about five per cent of tar, daubed on hot, and then glazed smooth with a blow-lamp. This process, however, is costly in time and labour, and hardly practicable for general use. We have, therefore, tested a number of patent proprietary coatings, and find an excellent and suitable material in the "Bitumastic Solution" of Messrs. Wailes, Dove and Co. Ltd. (Newcastle, etc.). This is a fluid "paint," easily and quickly applied with ordinary brushes, and dries rapidly to provide a brilliant black coating of flexible and durable nature which is, when mature, quite unaffected by chlorinated water, and prevents any action of the latter on the zinc of the tank. The hydrogen-ion concentration (PH) remains that of the original chlorinated water even on prolonged storage (compare Unprotected Tanks, para. 5).

It was of interest to find, however, that the rate of disappearance of free chlorine is considerably delayed, traces being found up to even seven hours after administration. This suggests that in unprotected tanks a considerable proportion of chlorine is "absorbed" in chemical reaction with the container walls. This is usually allowed for by adding extra bleach for the tank wall, just as, in making tea, an extra allowance is made for that deviated "by the pot." It has also a hygienic bearing in that it ensures sterility of treated water for several hours—a point of importance. Waters which are chlorinated centrally in large tanks often undergo considerable pollution in later handling of smaller quantities from which all chlorine has disappeared. This should be less likely to happen with waters from bitumastic-lined tanks, containing traces of free chlorine.

As to the question of taste, v. infra. This substance would therefore appear to provide a valuable means of preserving tanks from corrosion, whether of zinc, iron (as are many water-carts) or even wood, as well as of preventing the solution into the water of objectionable elements, inorganic or organic. We have found some sixteen cubic centimetres only are required to give two good coats per square foot. At a cost (1920) of 64 shillings per hundredweight of ten gallons (i.e., over 4,500 cubic centimetres) the inside of a water cart, which has a surface of less than

forty square feet, can thus be protected for less than 1 shilling; and a 400-gallon tank for less than 2 shillings.

(8) TASTE.

In considering the taste of chlorinated water from tanks we have found it necessary to assume two factors: (a) Taste derived from the container, and (b) an inherent "chlorination" flavour. In assessing results, tests were made on four officers, all ignorant of the nature of each sample, who judged each both as water and as freshly made tea.

(1) It was found that in water from unprotected tanks there was a very strong "chemist's shop" flavour, probably largely due to zinc compounds, and much more marked than that in water from protected tanks. Lime- and cement-washing remove the metallic element, but the water is still fairly strongly flavoured. In tanks lined with bitumastic solution there is at first a strong sooty taste of tar-oils, but this passes off after some two weeks; later tests showing only the merest trace of inherent "chlorination flavour." It would thus be necessary, after protecting tanks with bitumastic solution, to allow a preliminary fortnight for maturation, prior to ordinary use; during this time several fillings would be needed to extract the tar-oil flavour. With such treatment, the Wailes-Dove preparation appears to be well suited for military purposes, and would give longer duration of useful life to both water-carts and tanks.

(2) As regards what we have called the "inherent chlorination flavour" we have no definite explanation to offer. It is often suggested that the chlorine reacts with the nitrogenous radicle in the bodies of minute forms of life to produce chloramines, and that the latter, or perhaps also the essential oils liberated on destruction of these minute organisms are responsible for the flavour; certain it is that flavour is more pronounced in dirty tanks with an organic film coating the walls. But we doubt the adequacy of the chloramine theory, as the chlorination of pure freshly distilled water in sterile glass vessels resulted equally in a flavour which an unspoiled palate definitely recognized as belonging to the usual type. The flavour cannot be due to free chlorine itself, as it persists long after all traces of the latter have disappeared. Quite conceivably it is related to the calcium base, when bleaching powder is employed, as the application of amounts sufficient to yield only one part per million of free chlorine give a definite flavour to a sensitive palate, even when mixed in clean glass vessels. The matter is, however, of little import when protected tanks are employed; and special treatment of small quantities of water within units does not appear justified. In large bodies of water, such as municipal supplies, Houston recommended the use of potassium permanganate (Applied Chemistry Reports, vol. iv, p. 466), for de-tasting, and this method had previously been successfully used among the British Forces in France. We have, however, found it unsatisfactory for small (e.g., tank) supplies unless with some twenty-four to thirty hours contact—an impracticable time when dealing with water-carts and field tanks. In the more elaborate

170 *Action of Chlorinated Water on Galvanized-Iron Tanks*

pressure sterilizing plants, on motor lorries and barges as well as in stationary plants, effective de-tasting is produced by sulphur dioxide gas. Further tests are in progress in the hope of finding some simple and precise means of eliminating taste from small supplies, but at present a slight and innocuous flavour must be regarded as inevitable even in the best protected tanks.

(9) METHODS.

The data of this précis were obtained as the result of many hundreds of analyses carried out over some nine months in the laboratories of the Army School of Hygiene while at Blackpool. For simplicity, average figures only are given throughout. The methods employed to test taste have been referred to.

(1) The rate of disappearance of free chlorine was checked by titrating samples of 100 cubic centimetres of the tank water, withdrawn at half-hourly intervals, with sodium thio-sulphate, using starch-potassium-iodide as indicator; the thio-sulphate being of such a strength that each cubic centimetre was the equivalent of one part per million of free chlorine.

(2) The zinc content of the tank water was estimated at half-hourly intervals by comparison, with "colorimetric" standards, of the turbidity produced on adding to 50 cubic centimetres of the sample 0.2 cubic centimetre of each of 10 per cent sulphuric acid and 5 per cent potassium ferrocyanide. This turbidity is capable of comparison even when zinc is present in dilution of only a half part per million. The series of standards was made up from a stock zinc solution of 1 in 50,000, prepared from the sulphate. Two and a half cubic centimetres of this stock, for instance, made up to 50 cubic centimetres, give a 1 in a 1,000,000 solution, and stronger solutions can be prepared equally easily; when a range has been prepared, the precipitating reagents are added to standards and sample simultaneously.

Occasional more accurate gravimetric estimations were made to check results, as follows: 500 cubic centimetres of the sample, in which all the zinc was dissolved by sulphuric acid, were concentrated by evaporation, and the contained zinc precipitated as the carbonate by sodium carbonate. The filtered precipitate was ignited and weighed as zinc oxide. The resultant figure multiplied by 0.8026 gives the weight of metallic zinc. This method was, however, too long for routine work.

(3) The reaction was tested, as CaO, by titrating 100 cubic centimetres of the sample with N/20 sulphuric acid, using phenolphthalein as indicator; and total carbonates in similar fashion, but with methyl orange as indicator. The hydrogen-ion concentration was tested, for the PH value, by a colour comparator, as described in Medical Research Council, Special Report, No. 35. "The Reaction of Media"; 5 cubic centimetres of the sample, to which 0.5 cubic centimetre of a 0.01 per cent solution of phenol red has been added as indicator, being compared by transmitted light with a series of standards prepared from M/15 Na_2HPO_4 , $2\text{H}_2\text{O}$ and M/15 KH_2PO_4 to give PH values from 6.6 to 8.0.

MODERN FOOTWEAR AS A CAUSE OF FATIGUE, MUSCULAR RHEUMATISM, AND FLAT-FOOT.¹

WITH NOTES ON AN IMPROVED TYPE OF BOOT.

By S. D. FAIRWEATHER M.B., CH.B. ABERD.

THE arch of the normal human foot may be compared to the semi-elliptical spring employed in motor-chassis construction; the body-weight, however, does not rest constantly upon the crown of the arch or spring, but is thrown on it only when the resistance of the arch is required to deaden any jar or shock thrown on the foot. The arch, which rests on three points, the heel, the ball of the foot and the fifth metatarsal bone, is supported by the plantar ligaments and fascia, assisted by the ligamentous action of the various muscles—tibiales anticus and posticus, the long and short flexors of the toes, abductor hallucis, and the small muscles of the sole of the foot. Of these muscles, tibialis anticus acts on the whole arch from above, lifting it as one lifts a bunch of keys by a ring, ensuring that the antero-posterior arch will act in the proper plane, and preventing rotation of the arch around its long axis. The peroneus longus braces up the transverse arch diagonally, but if unopposed by a properly developed tibialis anticus it tends to pull down the antero-posterior arch. Flat-foot accompanied by spasm of the peroneus longus corroborates this point.

The *spring* of the human foot does not depend so much on the curvature and thickness of the arch as on the quality (strength, contractability, and relaxability) of the muscles which support it, just as the efficiency of a metal spring depends not on the curvature and section alone, but on its flexibility and strength. While, however, the height of the arch is no true criterion of efficiency—otherwise pes cavus would be the ideal foot—and a long foot with a comparatively low arch *may* be quite efficient, the ideal arch should be fairly high in order to obviate the necessity for the excessive contraction of the supporting muscles, which must take place before they can resist any strain thrown upon the foot, and which is unnecessary if the muscles and tendons are of the proper length. The height of the arch should be measured from the head of the astragalus to the ground whilst the subject is standing erect on one foot. A great muscular development under the arch partly fills up the concavity and makes the bony framework appear lower than it really is. The present method of testing for flat-foot—i.e., asking the patient to stand on tip-toe—is no criterion of the efficiency of the arch except in cases in which the bones are ankylosed. Most of the work of rising on tip-toe is done by the gastrocnemius and soleus, the tibialis posticus and peroneus longus helping

¹ Reprinted from the *Lancet*, 1921, ii, 1019.

the calf muscles to maintain this posture. The efficiency of the arch can best be gauged by marking the tubercle of the scaphoid while the subject stands on one foot, the tubercle being then allowed to sink as near the ground as possible and then elevated by contracting the tibiales and all the plantar flexors. Measuring the distance the scaphoid has moved and multiplying by the weight of the person will give the efficiency of the arch.

MODERN FOOTWEAR.

In a normal barefooted white man the body-weight when standing falls opposite the heel, i.e., on the posterior pier of the arch which is more vertical, more rigid, and shorter than the anterior, and not on the crown of the arch; the balance of the body being so perfect that only a minimum of effort is required to keep erect. When the heels are raised even a quarter of an inch from the ground the centre of gravity is thrown forward, the plumb-line falling opposite the crown of the arch or even farther forward, according to the height of the heel from the ground (figs. 1 and 2).

In healthy feet the higher the internal malleolus is naturally from the ground the easier it is for the internal malleolar group of muscles to do their work, getting as they do a straighter pull than when the malleolus is low down; and, conversely, the nearer it is to the ground the greater is the work required of these muscles. Artificially raised heels might, therefore, be expected to make the work easier, and this would doubtless be so were it not that the centre of gravity is thus thrown forwards, giving the muscles too much *constant* work. Even with a moderate, e.g., a three-quarter inch, heel a plumb-line falls not opposite the sustentaculum tali, but opposite the head of the astragalus, throwing a constant strain upon the inferior calcaneo-clavicular ligament and the tendon of tibialis posticus; to relieve this strain the feet are usually instinctively splayed. Correct alignment is as necessary in a walking machine as in any other mechanism if one is to secure efficiency and durability, and the nearer the toes are kept to the middle line (the line of progression) the greater is the economy of power. When the habit of walking with splayed feet becomes established, propulsion in walking is done by the outer half of the gastrocnemius and by the peronei, dorsiflexion (if any) being effected by the extensors of the four smaller toes and the peroneus brevis and tertius. The tibiales and the flexors of the big toe then get practically no exercise and become relatively longer and weaker than the evertors, propulsion thus being effected by the muscles which raise the outer side of the foot and tend to flatten the arch. Teachers of dancing, gymnastics, and physical culture to this day almost invariably teach their pupils to stand with their feet splayed, quite oblivious of the evil effects. In the Army also men are trained to stand "at ease" with the feet at an angle of 45° , the weight of their bodies and equipment being equally divided between their heels and toes, that is, resting on the arch. No wonder then that at least

ninety per cent of the temporary army were more or less flat-footed. The mere act of separating the big toes from each other tends to lower the arch of a weak foot, as the invertors of the foot are idle and the evertors in a favourable position for contracting. Also, the weight is thrown rela-

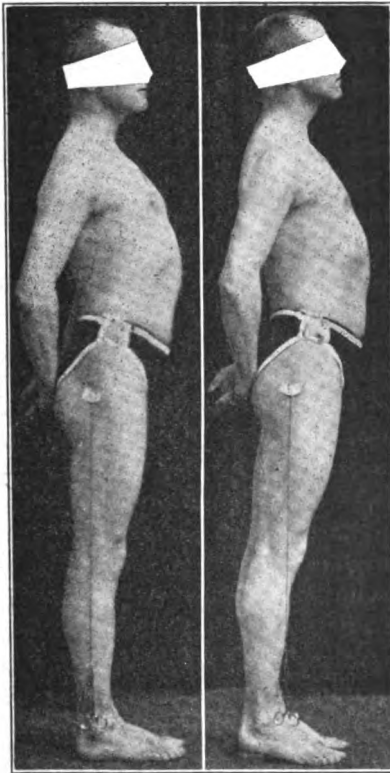


FIG. 1.

FIG. 2.

FIG. 1.—The muscles are equally relaxed and a minimum of energy is required to stand erect with the heels on the ground. The photograph was taken after wearing heelless boots for two years. The foot is quite altered in shape, the heel not projecting behind the leg as it formerly did. The plumb-line falls from a point vertically below the centre of gravity—i.e., the last lumbar vertebra, as nearly as could be judged.

FIG. 2.—The back muscles, quadriceps, glutei, and calf muscles are contracted by conscious effort to retain the erect posture; even then the latter is not so good as in fig. 1. The weight of the body is thrown on the spring ligament and internal malleolar group of muscles, to relieve which, when these muscles are weak or tired, people separate their feet in front. They then tend to walk with the feet everted, and the peronei do more of the work in walking than they should: there is thus a dragging down of the arch. Moreover, the tibialis anticus is elongated and weakened.

tively further inward and forward on the arch than when the big toes are kept parallel. Abduction of the big toe from the other toes helps to raise the arch, but in most boots this is prevented by the snow-plough shape of the front of the boot pushing the big toe outwards. No appliance can cure

hallux valgus whilst such boots are worn. Training, raised heels, and badly shaped toes of boots thus encourage men to stand with feet splayed and in course of time to walk in the same way, with the result that the muscles capable of making the arch strong and elastic are prevented or discouraged from acting effectively.

STRAIN RESULTING FROM WEARING HEELED BOOTS.

A man wearing heeled boots stands on a slope, the gradient of which depends on the height of the boot heel and the length of the arch. If the body and legs were not furnished with joints he would resemble the tower of Pisa, but up till old age muscular action to some extent corrects the tilting, and enables strong persons to preserve a fairly erect carriage, the back muscles, and the extensors of thigh, leg, and foot unconsciously coming into action. When a soldier stands at "attention" all these muscles are in contraction to an extreme degree. The civilian is content with a milder effort, and although these muscles are contracted, there is a perceptible bending of the knees, the joint never being completely extended, and the capsule and lateral ligaments constantly stretched, accounting possibly for the frequent complaints of weak knees and easily displaced cartilages; there is a forward bending of the head; the lumbar curve is somewhat flattened; the feet generally splayed; and there is a slight stoop of the shoulders and a corresponding partial contraction of his chest. These faults disappear while exercising in a gymnasium, returning as soon as boots are resumed. The compensatory flexion of the knees is concealed by the clothing, but may be observed in the bare knees of schoolboys and of men wearing kilts, and in theatrical women wearing tights. The tibia is then inclined slightly forwards, and the leg cannot be maintained in this position without wasting neuro-muscular energy. The exhaustion and even pain caused by the continuous contraction of the calf muscles and peroneus longus when heeled boots are worn may be relieved by discarding boot heels, thus relaxing the muscles, the operation of excising part of the peroneus longus tendon being quite unnecessary. That white men's calf muscles are "muscle-bound" is shown by the fact that if a soldier's feet be examined when he is lying on his side his toes are invariably pointing downwards, the foot being at an obtuse angle to the leg, instead of at right angles as it would be if all the leg muscles were relaxed, and as it is seen in an infant. Gray and Cunningham both state that in the erect position the foot is at right angles to the leg. This, I contend, is the natural angle of the foot also when resting, the extension of the foot being caused by the tone of the calf muscles being greater than that of the dorsiflexors. Boot heels, by causing the calf muscles to be "muscle-bound," are responsible for the belief that extension is the normal position of the foot when at rest, the point being of some practical importance in fracture of the tibia, where the unrelaxed calf muscles tend to cause over-riding of the broken ends of the bone.

The average height of the heel of a man's boot is $\frac{3}{4}$ inch, and this is sufficient to throw a man's head nine inches off the vertical if he is five foot, seven inches in height. If he weighs eleven stone, the weight required to pull him back to the vertical position is fifty-six pounds. This may be verified roughly by using a log of wood of this height and weight with a base of the same width as the arch of the foot (six inches), tilting it by a block $\frac{3}{4}$ inch thick and attaching a rope and weight led over a pulley. A soldier has also his equipment (say sixty pounds) to support, in addition to the fifty-six pounds mentioned above, thus doubling the weight he is supposed to carry. No matter how he distributes the equipment around his body, he has to exert a constant effort to resist the 116 pounds pulling him downwards and forwards which would not be the case if his boots were heelless. This is doubtless one factor in the ætiology of soldier's heart, as even a healthy heart is not always equal to the strain. Indeed, without suggesting that boot heels cause all the troubles that flesh is heir to, it is quite possible that they are a factor in the causation of many conditions due to fatigue and nervous exhaustion. Much of the physical incapacity in persons over 50 years of age which is attributed to "old age," rheumatism, and sciatica arises from the strain on their musculature caused by the constant wearing of heeled boots.

It is obvious that the higher the heel, the greater is the muscular effort necessary for the maintenance of the erect position. The head of a woman 5 foot 6 inches, with an arch 6 inches wide is thrown 2 foot off the perpendicular when she wears a 2 inch heel, thus entailing a great strain on the muscles of the back and necessitating the use of corsets. A person wearing very high heels becomes practically digitigrade, the weight being transmitted from the tibia vertically down the tarsus and metatarsus, falling not on the crown of the arch but vertically down the anterior pier. Although in this position there may appear to be quite a good arch, the feet are in many cases quite flat from weakness of the invertors and plantar flexors, and persons accustomed to the wearing of such heels are useless at long-distance walking, quick walking, or at any test of strength of the arch, such as leaping. The average woman gets no spring from the arch of the foot, being content with a lateral wobble of the ankle and rotation of the foot around its long axis instead of the natural springy heel-and-toe action. Any elasticity she gets is from flexion and extension at the knee, her feet being no more springy than blocks of wood. Using the knees in this way involves a much greater expenditure of energy than when the spring is derived from the action of the arch of the foot, and the movement produces a much less graceful effect as the muscles employed are larger and less capable of fine movements.

It is noteworthy that an exceptional proportion of the prize-winners in jumping competitions at Highland games are tailors, the reason being that these men when at work sit in a squatting position with the feet well

inverted. In spite of indoor life and lack of exercise, the average tailor is more agile than other men, as the arch is spared the work of supporting his weight all day, and his muscles, being idle, remain elastic. Sedentary people in general—e.g., clerks and students—are more agile than men who stand much, such as policemen and tram drivers.

THE HEELLESS BOOT.¹

To prevent and cure flat-foot and the other evil effects of heels, the boots should be so constructed that the metatarso-phalangeal joint of the big toe, all the toes, the outer side of the sole, and the heel shall rest on one plane parallel to the ground. Under the arch of the foot the sole should be curved with the convexity upwards and should be fairly flexible. The leather sole, which could be reinforced by spring steel from the heel to the ball of the big toe, should conform to the natural shape of the foot, and the heel and sole must be of the same thickness. The inner edge of the boot should be straight, as in American boots. Ample room should be allowed for flexion of the toes. The arching of the sole is not essential to cure flat-foot, but it looks better and allows the boot to be laced more firmly, thus compensating for the loss of muscular sense that occurs in a foot when any sort of footwear is used. Lacing the ordinary boot tightly pulls down the crown of the arch towards the flat sole which, being rigid, cannot fit into the arch. The ideal boot as described is practically a close-fitting, pliable covering of leather, supporting without immobilizing or hampering the structures in the arch and ankle, the waist of the boot acting like an artificial annular ligament, bracing up the strained fascia and ligaments under the arch (fig. 3).

With heelless boots the carriage is erect and easy, and the improvement in balance is very marked when turning round, golfing, waltzing, etc. It is noticeable that footwear used for boxing, wrestling, tennis, athletics and gymnastics, all of which exercises call for a maximum of strength, speed, and accuracy of footwork, is generally made with little or no heel. Owing to the os calcis resuming its natural relation to the ground, the calf muscles have a greater range of contraction, and this is shown by increase of power in high jumping and walking uphill. There is also a greater sense of firmness in the knees and ankles when standing, as also greater agility and quickness of foot work. In walking the feet should be kept parallel and a gliding movement of legs and feet adopted, the "steam-hammer" method of putting the feet to the ground being abandoned. The knee should scarcely be flexed and must not be raised, each foot being dorsiflexed in passing the other. Walking from the hip-joint and ankle should be cultivated, knee-joint action being only slightly required in correct walking.

¹ Very satisfactory boots and shoes of this type are supplied by Messrs. James Lorimer and Son, Aberdeen.

On first dispensing with boot heels walking is not quite pleasant owing to the spastic or muscle-bound condition of the calf muscles and the relative weakness of tibialis anticus, but as the latter recovers tone and peroneus longus and the calf muscles relax, the muscular balance is gradually restored (fig. 4). Soon the legs get straighter at the knees, the figure becomes more erect, the shoulders and head resume their natural position, the chest measurement gets larger and breathing easier, the back muscles get less spastic and the abdomen flatter, the foot gets shorter and



FIG. 3.



FIG. 4.

FIG. 3.—“Heelless boot,” showing heel and sole of same thickness, arched sole, and no curling up of toe.

FIG. 4.—To show development of tibialis anticus. When heels are worn this muscle is rarely as well developed as the calf muscles and peronei.

more shapely from raising of the arch, the tendency to eversion disappears, walking becomes a pleasure, and health, strength, and stamina improve. Immediate good results from discarding heels should not, however, be expected, muscles which have been in more or less continuous contraction for years being, of course, incapable of relaxing the instant the strain is removed.

Nurses suffering from flat-foot are usually advised to abandon high heels, but changing to lower heels does them no good, what is required being no heels. A person wearing a heelless boot can tolerate a much

thicker sole than he would in an ordinary boot, the movement in walking in the former being quite different from the modern artificial walk.

REMEDIES FOR FLAT-FOOT.

Many of the remedies hitherto employed are useless, among them being (a) arched supports in heeled boots, which are usually either too strong to be flexible or not strong enough for the constant weight of the body; (b) raising the inner side of the sole and heel, which is only a palliative and not a cure; (c) standing tiptoe exercises and cycling, both of which are injurious as they develop the calf muscles and peronei longi which are invariably relatively too well-developed already, and do not sufficiently exercise tibialis anticus. In cycling, dorsiflexion of the ankle being done chiefly by the descent of the opposite pedal, tibialis anticus does not require to contract actively. Tiptoe exercises with the heels separated and big toes touching also fail, as abducting the heels is not equivalent to inverting completely the feet (abduction of the heels being done from the hip-joint), and rising on the toes in this position does not exercise the tibialis anticus, which is relaxed instead of contracted during the movement. In standing tiptoe exercises most of the work is done by the gastrocnemius and soleus, the other muscles of the leg unaided being incapable of raising the body to the tiptoe position as they act round corners (the malleoli). After the calf muscles have initiated the movement, the tendons passing under the malleoli come into play, and, when on tiptoe, help to preserve this posture. The exercise is unnecessary, as the same movement takes place in spurning the ground in walking, with the advantage in the latter case that during the contraction of the muscles of the propelling leg the weight is for the moment on the other foot. In heelless boots the movement starts from the ground, and the calf muscles have therefore a greater range of contraction, so that the tibialis posticus group have a longer time to get into action. Also in walking the flexor longus hallucis gets a chance of complete contraction, whereas in tiptoe exercise the sole of the big toe is on the ground and remains more extended than flexed.

What is required then is to exercise the arch supporters independently of the peronei and calf muscles, the three essential exercises in addition to correct walking as already described being: (1) dorsiflexion; (2) plantar flexion; (3) inversion. Unless, however, boot heels are permanently discarded, perfect feet cannot be expected from these or any other exercises.

(1) Dorsiflex the inverted foot, helping with hand if necessary, and getting someone to pull down the heel if the calf muscles cannot relax voluntarily.

(2) Plantar flexion should be performed with the inverted foot (a) flexed; and (b) extended, an attempt being made to close the foot like a fist. After thorough contraction, relax all the plantar flexors completely,

and repeat contraction and relaxation alternately, concentrating the attention on the process. This exercise should be done with the foot in the extended position only when the patient has intelligence and power enough to keep the gastrocnemius and soleus relaxed.

(3) Invert the foot completely, with foot extended and flexed respectively. Relax. Repeat.

Other useful exercises are: (4) Walking on the outer side of the feet and lifting each foot to cross the other at each step. (5) Lifting gradually increased weights with the inverted foot. (6) Circumduction of the foot from without inwards—i.e., invert, dorsiflex, extend. Relax always after each completed movement in every exercise. (7) Separate big toe from the others. Adduct it. Relax. Repeat. (8) Sitting on chair extend knees to the utmost, dorsiflexing the feet at the same time. Relax. Repeat. (9) Standing on heels and outer sides of feet, toes off the ground, lean back as far as possible. (10) Walking in boots the soles of which are thicker than the heels. Old boots with heels removed and soles thickened are useful for this exercise. Passive movements, massage, and electricity are all useful adjuncts, but none is essential. Where, however, adhesions or ankyloses exist, they should be broken down before starting treatment.

NOTES FROM A D.A.D.P. AT A HOME STATION.

BY MAJOR R. G. S. GREGG.

Royal Army Medical Corps.

SINCE the Directorate of Pathology has been established I do not remember having seen any article in the Journal describing in general the work of a D.A.D.P. at home. Consequently it has suggested itself to me that my experiences and impressions during the past sixteen months at Cork might prove interesting.

Following on the comprehensive Senior Officers' Course at the Royal Army Medical College orders were received to proceed to the Irish Command. A posting to Cork followed with instructions to take over the District Laboratory at Cork, and, after an interval of instruction from Captain J. S. K. Boyd, R.A.M.C., to relieve him of the charge of the venerable laboratory at Spike Island.

The district laboratory proved to be a small brick building of two rooms built in the days when hygiene dominated laboratory work. The larger working room held a central table with numerous drawers, two sides were bordered by inconveniently high working benches with windows above and more drawers below, the third held cupboards and bookshelves and the fourth a stove and door. Four tall office stools were provided perched on which high above the floor one was confronted with the problem of whether to work at the part of the bench above the drawers, which eliminated all room for one's legs, or to demand comfort for one's lower extremities and sit at work faced by a round basin inserted into the bench and taking up most of the table space. However difficulties were solved by a compromise and moving from stool to stool as occasion demanded—a sort of Cox and Box entertainment in which my assistant also joined.

I was extraordinarily lucky in what is probably the most important respect; my assistant Mr. Southall (ex R.A.M.C.) was a most keen and reliable worker, with an excellent knowledge of everything that was required and willing to learn new methods, and quite unselfish of time given to his duties. By contrasting him with my previous experiences of Indian laboratory "boys" I can honestly say that the assistant makes the most important factor in the work that can be attempted in a laboratory.

The equipment was patchy, bearing traces of half completed indents in war time—for instance, every article needed for the Leffman Bean estimation of fat in milk was present except the special centrifuge, and the microtome was alone missing amongst the apparatus required for cutting sections.

The first measure consisted in making out indents to supply deficiencies

in equipment and to arm one's self with all the apparatus and stains necessary for the work learned at Millbank.

Simultaneously correspondence was started to obtain a licence to conduct animal experiments.

In the same month (September, 1920) an outbreak of typhoid fever occurred in Cork, and with indents not yet supplied and one Dreyer's outfit only for agglutination tests it became necessary to improvise; a tin box with holes bored in the lid, part of the bottom cut away, and some perforated zinc inside, the whole tied with string, made a somewhat unsightly but useful "toy," and as an electrically-heated water bath was ready a good many agglutination tests were performed.

Cultures of blood, urine, fæces, and rose spots produced *Bacillus typhosus*, and out of eleven clinically positive cases ten were diagnosed by culture and one by agglutination of the serum.

A visit to Spike was made once a week which provided a pleasant change and the opportunity of seeing Captain Boyd at work on the Rochester Row and ice-chest methods¹ of the Wassermann test.

At this time all the venereal patients in hospital from the Irish Command were at Spike, but parcels of sera arrived weekly from all parts of the country.

The laboratory at Spike was in a three-roomed sixty-foot hut with plenty of space and comfort and up-to-date equipment. Clinicians and bacteriologists could work in close proximity and understanding. Captain Boyd was then engaged in his comparison between the two methods of the Wassermann test, his conclusions being published in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS for May, 1921.

At this time also occurred in Cork the case of gunshot wound complicated with *B. enteritidis* infection reported in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS in July, 1921.

At Cork it was necessary to have housing accommodation for animals in view of the licence applied for; the Officer Commanding Military Hospital offered me an old cookhouse and the engineers were approached to make it suitable. Plans were drawn up and submitted but the estimates proved too expensive, and a retrenchment having to be made, at length, in August, 1921, the hut was ready and guinea-pigs were acquired. The licence had not taken the expected time to materialize, and in December, 1921, I was armed with full powers to vivisect but the animal accommodation was lacking.

Seeing painters in the hospital one day an effort was made to have the laboratory re-distempered. The workmen were trapped and the walls cleaned; tearing down a chart of the physiology of the lungs one found underneath an old diagram illustrating "Eight Years' Sanitary Effort at

¹ Method proposed in Report No. 1 on Public Health and Medical Subjects issued by Ministry of Health, 1920.

Home." The superposed dust of the succeeding years caused one to moralize how seldom sanitary effort begins at home.

At this time the number of specimens examined in Cork was from 200 to 250 per month, the typhoid epidemic and the Gärtner case providing the chief interest outside routine work.

Also might be mentioned a patient who had suffered from bilharzia and whose urine was examined daily for months for ova without success, though the relative white cell count showed throughout between nineteen and twenty-three per cent of eosinophiles.

Apart from the medium used for recovery of the Klebs Loeffler bacillus all throat swabs were plated out on to boiled blood medium and various organisms recovered, but no correlation with clinical symptoms of value was noted.

About November, 1920, old stocks of inspissated serum having been exhausted we decided to use Dorset's egg medium for the recovery of *B. diphtheriae*. It was with fear and trepidation that I instructed Mr. Southall to make the attempt: nothing abashed he set to and produced twenty-four tubes, 100 per cent sterile. As the ingredients in the preparation of this medium are never raised above 70° C., and as accidental contamination might be expected I regarded this as an extremely lucky event. However, succeeding batches proved as good and a contaminated tube remained a rarity. This proved up to the hilt the reliability of my assistant. One objection I found to Dorset's egg medium was the facility with which other organisms also grew upon it, so that the isolation of the Klebs Loeffler bacillus in pure culture was made more difficult.

The engineers were persuaded to make a cupboard with numerous sloping compartments for the sugars and other media in test tubes, and also a rack with 220 holes to hold stock cultures; with the subcultures brought over from Millbank and those recovered in Cork it was possible to keep three generations of each.

About Christmas, 1920, the equipment indented for began to arrive. There was some misgiving as to whether it could all be accommodated in the small space available. However, the cupboards and drawers proved capable of holding a tremendous amount, and as there was little superfluous equipment it all fitted in.

On October 18, 1920, I had taken over the Spike laboratory from Captain Boyd and travelled there via Queenstown and War Department launch on Tuesdays and Wednesdays each week. By a carefully regulated time-table it was just possible to complete the Rochester Row method on the Tuesday and also to add the I.C. extract to the serum-complement mixture and put into the ice chest, to be finished on the next day. It required fast working and concentration all the time to catch the afternoon launch, and if visitors found one's answers somewhat brusque they must forgive the necessity for asking for no interruptions. One was safeguarded from other work intruding and a telephone message to Cork before leaving the island assured one that things were all right there.

On the Wednesday the ice chest method was completed, correspondence attended to, and results were checked and despatched.

Between November, 1920, and July, 1921, 1,700 Wassermanns were performed, all by the Rochester Row method, and the majority by the ice chest method.

One point that helped to establish a measure of confidence in one's reports was the close agreement between both methods. Another clearly brought out by Captain Boyd in his report was the sensitiveness of the ice chest method to the Wassermann substance, especially in cases under treatment. Where the results differed, it was generally in cases of diagnosed syphilis under treatment, which were found negative by the Rochester Row method, and positive by the ice chest method. Whether this degree of "positiveness" calls for further treatment or not appears to be unsettled. According to Mr. J. E. R. MacDonagh, in a paper reported in the *Lancet* for December 24, 1921, "Those with a large clinical experience are coming to the conclusion that a negative reaction signifies nothing, and that a positive reaction means nothing more than that the patient has had syphilis. It is now being recognized that the reaction can be used, neither as a regulator of treatment nor as a test of cure, and that a positive reaction does not necessarily signify that the disease is active, and that the patient requires treatment." Another advantage in performing the tests by two methods lay in the fact that sharper readings were sometimes given by one method and sometimes by the other, as judged by several control sera, and help was thus afforded in the border line cases. There was a close agreement in primary (A) cases for diagnosis: when in any doubt as to sufficient "positiveness" a provocative injection of "914" and the sending of a second specimen were suggested.

The formalin method was also tried with all the samples of formalin procurable, and with various sized drops with most discouraging results. Even partial coagulation of the serum did not often occur, and sometimes took four to five days to appear, and when it did seemed as likely to take place in a serum negative by other methods as in a positive. Of nineteen sera positive by the ordinary methods, seven were positive and twelve negative by the formalin test; of fifty-two sera negative by the ordinary methods, six were positive and forty-six negative by the formalin test.

At the end of December, 1920, the venereal patients were moved to other hospitals, but the laboratory remained until the end of July, 1921, when its equipment was transferred to Dublin.

It was suggested that the Wassermann reaction should be continued in the interval at Cork, but this was resisted on the grounds that the extra equipment could not be accommodated, and chiefly that there was neither elbow room nor foot room for the test. It is essential that the worker in this test should have plenty of table space, and be seated comfortably with feet on a sure foundation.

Numerous cases of dirty gunshot and bomb wounds were brought into

Cork hospital during the period. In February, 1921, gas gangrene, with rapidly fatal results, occurred in an amputation case: *B. welchii* was found post-mortem in the wound and in the heart's blood, the anaerobic media, meat, milk, alkaline egg, and coagulated egg in broth, working well. In March, 1921, three further cases occurred: in two of these streptococci were associated with *B. welchii*, and these cases seemed to run a milder course. A few injections of T.V.W.¹ were given to all three cases, and two recovered, but whether recovery was assisted by the T.V.W. or not the surgical specialist was not prepared to say. From this on, on the advice of the Director of Pathology, half a phial of T.V.W. was administered prophylactically to seriously wounded men in the Division in place of antitetanic serum, and gas gangrene cases were less frequent. Officers were also advised to give T.V.W. in large doses for treatment of gas gangrene: it would have been impossible to give this relatively weak serum in such quantities as to equal in units of antitoxin the amount administered to cases reported from France in special Report Series No. 39 of the Medical Research Committee, moreover, the concentrated serum was unobtainable, yet it appeared that the T.V.W. had a good effect. No further case of gas gangrene arose until July, 1921; this was a mild case, received three phials of T.V.W. and recovered. The next patient in October, 1921, had an extensive wound over the left hip and gluteal region: after operation he showed signs of gas which extended from the crest of the ilium to the axilla. Twenty phials of T.V.W. were given subcutaneously, and two phials applied directly to the wound and the patient recovered, the recovery being entirely due in the surgical specialist's opinion to the T.V.W.

The records show that in both these cases the prophylactic injection was antitetanic serum not T.V.W.

The cases are too few on which to generalize but the experience gained points to the fact that in dirty wounds T.V.W. has a real additional advantage to plain antitetanic serum as a prophylactic, and that in gas gangrene surgical measures may be considerably assisted by its administration.

A word must be said with reference to administrative work as a D.A.D.P.

The administration of T.V.W. has been referred to above.

As a result of the typhoid epidemic instructions were received to encourage inoculation as much as possible and to be prepared to give figures as to the inoculation percentage of units when called upon.

As Army Form I 1246 (Quarterly Inoculation State) had been abolished a local proforma on the lines of a suggested War Office proforma was called for quarterly; this stated by units total strength on a given date,

¹ A phial of T.V.W. contains the following units: Tetanus, 1,500 units (U.S.A. standard); vibion septique, 2,500 units; *B. welchii*, 2,500 units.

number protected, number inoculated with $\frac{1}{2}$ cc. T.A.B., number inoculated but not protected, number never inoculated, as well as number protected on date of previous return.

A pamphlet describing simple staining procedure, methods of making up staining solutions, and equipment necessary for such, and the routine to be followed in regard to certain diseases was issued to the larger hospitals for the establishment of small clinical laboratories in furtherance of instructions received from the A.D.P. Irish Command. These however did not materialize owing to the threatened withdrawal of troops from the Divisional area.

On visits to outstations the following points were investigated, sera and vaccines on hand, enteric inoculation statistics, venereal laboratory, facilities for general routine staining, methods of taking of specimens, whether further bacteriological examinations were wanted for seriously ill patients.

Here one may mention that the D.A.D.P. in this Division is informed of seriously ill patients on Army Form A21a, and the officers commanding military hospitals are encouraged to send for him in consultation or for specimen taking; needless to say, he is also the officer responsible for investigation of cerebro-spinal fever in the Division.

When inspecting the laboratory in venereal treatment centres, officers frequently consult the D.A.D.P. as to treatment.

Useful talks are thus indulged in, in which the scheme of treatment for venereal patients suffering from syphilis, the keeping of venereal case cards, the significance of the Wassermann reaction, and the use of detoxicated and other vaccines play their part.

But to return to the laboratory. With the equipment so readily and generously supplied in response to the indents one was able to tackle most tests that might be required.

Routine examinations took the largest share from the statistical point of view. The numbers of specimens examined in the month grew from 150 to 450; amongst them might be mentioned that 706 cultural examinations were made for *B. diphtheriæ*, and 233 films for tubercle bacilli in the sputum in the sixteen months.

In the beginning of the Autumn of 1921 the Klebs-Loeffler bacillus was found in the throat of one of the canteen workers admitted to hospital and diphtheria was diagnosed; examination of the contacts led to the discovery of Klebs-Loeffler bacillus in the throats of two others who though not suffering from diphtheria were then sent to hospital. An epidemic was feared, in association with the D.A.D.H. the workers were isolated, the Schick test was performed, and throat swabs taken, and the canteen was closed for a few days and disinfected, we were gratified that no further cases occurred. The pathogenicity of the organism must have been slight as one cubic centimetre of a pure culture in glucose broth failed to kill a guinea-pig when injected subcutaneously. The animal died however, of an intercurrent affection three weeks later, and then the suprarenals were found to be enlarged.

One is tempted to write a good deal about the more rare and interesting cases one came across, but in a general description this is hardly justifiable, however reference to a few must be made.

Blackwater fever occurred in a patient home from Constantinople—an old malarial patient—the urine answering to the text-book description. A few “rings” were seen in the thick drop slide on the first day and though no quinine was administered these did not reappear. So striking was this that one could well understand that in this case they might easily have been missed if one further day had elapsed. The suggestion occurred that malaria may be more often the cause of blackwater fever than is generally recognized. Can the malarial parasites in this disease have settled down to a local habitation (one would think of the convoluted tubules of the kidney), and be side-tracked from the blood stream and perhaps out of the reach of quinine? In this case the gradual recovery afforded very pretty blood pictures of a severe secondary anæmia not surpassed until the blood of a patient whose spleen had been excised was examined when he too became of the greatest interest.

To refer to a few more points of interest, sections were admirably cut by Mr. Southall, and cleared up some cases of doubt; lymphatic leukæmia on one occasion was “spotted” in the laboratory on seeing a blood slide with 94·8 per cent. lymphocytes (small and large) the total white cell count was 72,000 per cubic millimetre; an autogenous streptococcal vaccine was given with success for pyelitis, and prophylactic vaccination for colds was tried amongst men of the 2nd Staffordshire Regiment. However the constant drafting away of those under observation killed the benefits from the statistical point of view in spite of the keenness of the Commanding Officer of the battalion.

Three visits were made to outstations for suspected cerebrospinal meningitis and in two instances anti-meningococcic serum was administered by lumbar puncture. The recovery of the meningococcus was not effected though one case on clinical grounds was diagnosed as cerebrospinal meningitis; in this instance the contacts also proved negative.

One occasionally came across non-pathogenic organisms: being sent for to an out-station to see a case of septicæmia following middle ear disease, blood cultures into broth and MacConkey's medium were taken (the latter I found very useful for blood cultures for the typho-coli group): in both grew an organism which by its sugar reactions and its liquefaction of gelatin appeared to be of the proteus family: a few days later, a radical mastoid operation was performed and pus discovered: from this there was grown an organism similar to the first, but which did not liquefy gelatin nor change maltose (possibly *B. morgan* No. 1). Some days later from the ear discharge *B. proteus* was again recovered. The temperature was of the “spiky” variety, up to 105° F. and down again to normal, often associated with streptococcal infection yet no organism except the two I have mentioned could be found. Further operations were undertaken and no

extension of the suppuration was discovered either then or at the post-mortem. The *B. proteus* organism was clumped by the patient's serum up to 1 in 125, but one cubic centimetre of a broth culture injected into a guinea-pig proved it to be non-pathogenic. Antistreptococcal serum was tried without success, and as I did not consider that the organism causing the septicæmia had been found I advised against the use of a vaccine which I thought would do no good and on which false hopes might be built. I was unable to be present at the post-mortem and my request for cultures miscarried; macroscopically there was nothing of note except a small abscess at the base of one lung: sections of the liver, spleen, kidney and lung showed clumps of Gram-positive bacilli principally in the blood vessels, but as there was no inflammatory reaction in their proximity they were thought to have circulated shortly before death, and the cause of the septicæmia remained a mystery.

Relative white cell counts became very popular and were frequently asked for in doubtful septic conditions, tuberculosis and pneumonia patients, also in men appearing before medical boards and claiming disability for old malaria.

I must not forget to mention that the routine hygiene examinations of water (chemical and bacteriological), milk and air, were performed in the laboratory.

I feel that but the briefest reference has been made to the particular cases mentioned, and many more of almost equal interest have not been touched on. This article, however, is intended to be an attempt to show the variety of work encountered in a D.A.D.P. billet and I have endeavoured to avoid wandering into statistics and into strictly technical details.

I was greatly assisted in three important respects (a) having no work outside that of D.A.D.P., (b) being very generously treated as regards equipment, (c) having an ideal assistant.

THE CATARRHAL PHASE.

By MAJOR H. GALL.

Royal Army Medical Corps.

(Concluded from p. 119.)

THE notable wave of oral sepsis that has been a feature of recent years has been contemporary with the post 1905 period. The troublesome prevalence of gingivitis and stomatitis in the Army in the war was, as I believe, a development of the newly-aggravated tendency. It is of interest in connexion with this thesis that the question of vitamine deficiency in the Army was carefully investigated but excluded as the main factor in the case. The condition was giving much trouble among recruits a year or more after the armistice. Though these conditions are not now prevalent in the Army the tendencies concerned in their new endemicity still remain among the population at large.

Acute appendicitis has latterly become suddenly much commoner. It is said to constitute about seventy per cent of all "acute abdomens." Those interested in the rise of appendicitis—a rise from, apparently, almost *nil*—place its beginning in the eighties of last century. I think, however, that a great part of the increase has occurred under our eyes in the present century. All figures show at least a great increase in this more recent period. At the present time a steady supply of cases of acute appendicitis arrives at every hospital of any size. I believe the incidence is considered to fall chiefly on the younger ages. To some extent the suddenness of this increase in the number of "acute abdomens" and particularly of acute appendicitis is generally recognized and commented on. You may say that dental deterioration and unsuitable food, etc., account for this increase in acute abdominal disease, but you will find that some analogous increase is to be recorded for native populations who have practically not changed their way of life recently at all, and in spite of all I would say that the incidence of acute infective abdominal disease may be taken as a good index of the state of general health. Further, I believe that many surgeons feel that the sudden recent increase in these conditions is difficult to explain, and that they are in the same boat as physicians confronted with the new vagaries of certain medical diseases.

Now I come to what I consider a curious and significant feature of the times. In America, of all examinations for military service there were 115 rejections per mille for flat foot. In all, 300,000 were rejected on this head. In the United Kingdom the rejections for deformities of the feet was also high, but flat-foot is not usually given separately. It must be remembered that only fairly bad cases are rejected.

The tone of the plantar ligaments is, again, some index of general

health and condemns it if it is found in undue amount among those in whom excessive standing at work in youth and unfavourable circumstances generally can be excluded. After the first few years of this century there began a sudden mysterious increase in flat-foot in all strata of the population, women as well as men. Up to that time children were not subject to flat-foot apart from occasional valgus conditions of the knees and ankles or obvious constitutional disease, etc., which predispose to it. From then, however, flat-foot has become suddenly common in otherwise healthy children and this is a distinguishing feature of the prevalence of flat-foot which suddenly appeared in the population.

The falling annual death-rate for the United Kingdom and the grossly bad national health disclosed by the National Service Boards to say nothing of every day clinical experience form something of a paradox. We live somewhat longer than our fathers and are spared a certain portion of the disease they had to cope with. We are, however, overrun with minor diseases and their results and are less fit for work and endurance, a point which has something to say to the industrial troubles of our time.¹

This unexpected and exaggerated latent medical unfitness in the population is, I believe, of recent and sudden origin, and due, in my opinion, to a specific toxic absorption from the naso-pharynx. All the new activities of disease here dealt with are conspicuously indiscriminate as regards social circumstances, and this to an extent which rules out environmental and malnutritional factors as alone being primarily responsible.

I.

To return to our case of chronic bronchitis in the examination room. It will be understood that I think that there is more in the case than met the eye (as is, perhaps, not uncommon in cases met with in those circumstances). As an isolated case, would he have been considered particularly remarkable fifteen years ago? I think that the utter failure of a healthy young man to cope better than this with his infection might have been thought somewhat unusual. I have on two or three occasions of late heard just that comment spontaneously given utterance to about cases resembling this one. It is, however, the manner in which we are being inundated with cases showing an analogous failure against the respiratory infections that is certainly noticeable. The number of cases of more or less chronic bronchial trouble in young and healthy men is certainly abnormal. In not a few of these cases the lung condition exists concurrently with some other cause of admission to hospital, and so escapes record for statistical purposes; for example, the little outbreak of bron-

¹ The survival of the unfit under civilized conditions might perhaps be thought chiefly responsible for such phenomena. I consider, however, that the influence under discussion is something quite apart from that factor, though doubtless working to much the same ends.

chitis and broncho-pneumonia in the surgical wards of the Queen Alexandra Hospital mentioned above. In any case a very undue proportion of these men and boys so attacked never throw the thing off properly, nowadays, just as the rest of us do not get rid of our tendency to recurrent attacks of the clinically less important colds and catarrhs.

We have noted the simple and well-known parallel to be traced between the mastery gained by these catarrhs in the past few years and this new extension on the part of bronchitis. The former overcame our resistance to them in an early year of the century, and continue to dominate us. Nothing then is more natural than that something analogous should soon follow in the better fortified lower portions of the respiratory tract. If it was simply a matter of one bad year with much influenzal illness about, and a consequent increase in bronchial catarrh, etc., it would be nothing, but the present phase has been going on for years now and shows little sign of abating. The 1918 pandemic seemed clinically to be some kind of ordinary influenzal illness. When uncomplicated it was by no means a serious condition, though extraordinarily infectious and flaring through the world. Upon this illness followed the most malignant respiratory complications. In this I think an analogy may be traced with the tendencies we are concerned with. The pandemic was possibly an extreme example of a "catarrhal" or "influenzal" illness specifically weakening the powers of resistance of the lower respiratory tract to many common infections, which latter accordingly ran riot. The lack of proper resistance to the respiratory complications of that influenza, the failure in many cases of the protective powers of the body to put up even the beginning of a fight against them, impressed all who saw these cases.

Although there is of course nothing new in the sequence of infection of the upper part of the respiratory tract predisposing to infection lower down, especially in influenza none the less the process seems to have become suddenly specifically facilitated. In 1905 some link in the immunizing or protective processes was broken. The anomalous respiratory illnesses which began to appear in the world just before 1914 led direct into the anomalous respiratory illnesses seen throughout the war years and these culminated in the disaster of the pandemic.

II.

In the year 1905 this country, or at least a certain part of it, was visited by a rare and fatal pandemic illness of a very strange nature. In the summer of 1905 people began dying from strange illnesses in Hertfordshire. This was investigated as soon as it began to be felt that there was something amiss and an account of the outbreak was recorded by Dunn and Gordon in the *British Medical Journal* of August 26, 1905. It did not apparently immediately occur to those who met with this illness that anything unusual was in progress and this was because the condition was clinically so extraordinarily polymorphic that it

appeared as if a number of different and somewhat anomalous infectious illnesses had broken out at the same time rather than one disease. Measles, scarlatina, diphtheria, cerebrospinal fever, influenza, typhoid, etc., were all closely simulated in different cases. Some cases were exceedingly trivial, others were rapidly fatal, and cases occurring in the same house at the same time would exhibit these extremes in a startling manner. A common symptom of the great majority of these cases was a profuse coryza. This illness was remarkably infectious; so much so that possibly everyone in the districts in which it could be observed had the illness in some form. The mild forms masqueraded as a more or less severe common cold. The authors state that owing to the infectiousness of this remarkable illness it rapidly spread and probably passed far and wide beyond Hertfordshire so that its further progress could not be followed by them, but I have not come across any further references to it by any other writers.

Very rarely outbreaks of more or less similar nature have been recorded, according to Dunn and Gordon, but it seems possible that the Hertfordshire outbreak, if related to any precedent, was severer than former ones. It appeared in 1905 as a fatal, mysterious and elusive illness to judge by Dunn and Gordon's account of it.

In the late autumn of 1905 an irresistibly infectious coryza arrived in the London area and spread far and wide as I have some reason to believe. This coryza corresponded perfectly with the milder cases of the Hertfordshire outbreak which I did not know of at the time. The coryza in the London district was noticeably both more profuse and more universal than was usual even in the common cold however severe. A few cases showed a slight tendency to erythema on the face. I do not know whether any considerable proportion of cases corresponding with the more serious cases as described by Dunn and Gordon occurred, but these latter cannot have been very universal in any considerable portion of the country or the event would of course have been noticed and moreover would have been reflected in the death-rate for 1905. Anyway I was ignorant of the possibility of anything of the sort and was not on the look out for severe or fatal cases. The illness passed as a severe influenzal cold. No one brought into contact with the outbreak as it affected the human subject would have seen much reason to pay special attention to it. The whole population of the United Kingdom could catch a severe influenzal cold of this kind at the same moment without the fact being fully appreciated. But I think that an illness with some altogether new characteristics was camouflaged in this ordinary-seeming epidemic, or better, pandemic.

An accidental fact showed me that this pandemic might be a peculiar one. I was at the time going backwards and forwards daily between London and the south of Surrey. The pandemic raged unobtrusively in both places. In London I saw its effect among the members of various

classes I attended in those days. In the country, however, I saw its effect in two or three farmyards and this was rather astonishing. I do not think that any creature exposed to infection escaped, either four-footed animal or bird. A few animals were pretty seedy with it but none actually died that I knew of. The majority carried on as usual. All had the remarkably profuse coryza and as can be understood the *ensemble* was rather striking when the thing was at its worst.

Now this odd and extraordinarily infectious brand of coryza showed immediately a feature that has marked the catarrhs and respiratory illnesses of the post 1905 period, for it failed to resolve properly. The acute stage tardily subsided and drifted into a chronic rhinitis. This chronic rhinitis was marked by a tendency to acute exacerbations. This element of a failure of resolution applied, at first at least, equally to animals and men. The disease palpably had the protective resources of the body at a disadvantage from the beginning, and from that time suddenly began the post 1905 catarrhal phase marked by an abrupt change for the worse in the quantity, symptomatology and prognosis of the various conditions necessarily implicated. Thereafter the oro-naso-pharyngeal mucosa found itself at a disadvantage with the infections commonly assailing it.

I believe that the 1905 defect in certain immunizing processes of the body is one expression of an influence which then began to interfere with the *nutrition* of the body in a general sense. A defect in what is broadly understood as the nutrition of the body is to some extent estimated by the condition of the teeth and the hair, by anæmia and by the tone of the skeletal apparatus and so on, one might add also by the resistance to infective processes. More than one constitutional disease provides examples of this sort of thing but their effects tend to be gross and extreme. The post 1905 period has been marked by an appreciable general tendency to a similar condition of nutritional defect in the population.

In the years under discussion the teeth of young subjects in this country seem to me to have suddenly dwindled just appreciably in size. This I mean absolutely apart from dental caries. I submit a few photographs of teeth showing what I think are characteristic appearances of this specific slight stunting of the teeth. It is usually marked by some degree of tuberculation of the teeth, always if I am not mistaken a sign of some defect in their development or nutrition during the period of development. In the cases in question this is often particularly well marked in the upper bicuspids which appear almost double owing to the deep cleft dividing the tubercles, even a whole row of teeth, again particularly those of the upper jaw, will give this appearance of a double row of small looking teeth owing to this, I think newly, exaggerated tuberculation. This specifically stunted and tuberculated appearance suddenly rose into prominence immediately after 1905. The photographs in the text, figs. 1 to 3 show fairly well the appearances I mean. The appearances represented may be taken as very typical of the times and may be compared with the normal



FIG. 1.—A young soldier, aged 19. This boy was of quite good physique. The teeth were free from an undue amount of caries. There was no pyorrhea. The new post 1905 stunting of the teeth is well illustrated. The new characteristic double appearance of the bicuspid resulting from undue tuberculation is well shown.



FIG. 2.—A recruit, aged 18. Good physique. Excellent teeth as regards caries and pyorrhea. Observe the new pathological deep groove furrowing the back teeth. A defect in nutrition is clear. The double bicuspid appearance is also illustrated.

as figured in text-books of anatomy. I premise that these appearances in bulk date from the early post 1905 period and that they are now well established especially in the generation whose youth was spent in the early post 1905 period.

The shape of the erupted tooth is, I understand, immune from the effects of malnutrition affecting the body at large for the reason that the enamel once formed ceases to have any connexion with the rest of the body; i.e., it has no blood or lymph supply. The new catarrhal dental degeneration did in some, and probably many cases affect the erupted tooth in the early post 1905 period. This effect is presumably then due to chemical agencies resulting from new conditions affecting the bacterial

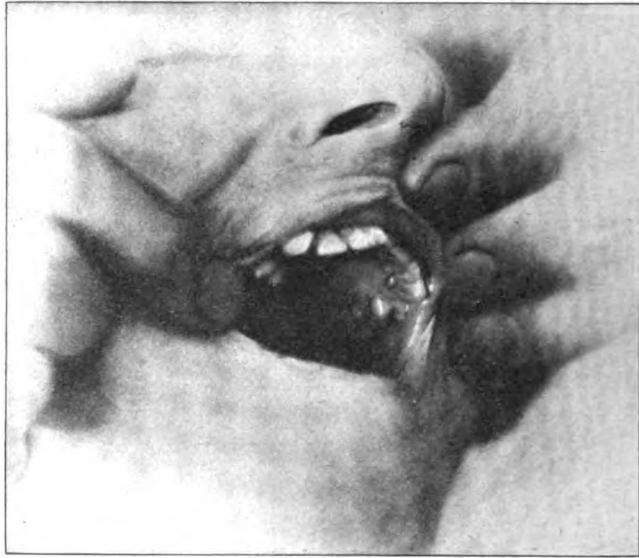


FIG. 3.—Recruit, aged 19. The new double bicuspid (left) in a less good set of teeth. In worse examples of the defect under notice the bicuspid tends to become pegged as well as bifid.

flora of the mouth, or something of that nature. Previous to the catarrhal phase, teeth were not often erupted mal-formed in healthy subjects nor did they subsequently become so, however soon they might be destined to become carious. Fig. 4 shows the case of an adult now aged 40 who had a good and normally shaped set of teeth in 1905. He then got the new catarrh with the result that within two years the condition of his teeth had characteristically regressed, his hair, moustache, and eyebrows had become noticeably thinner and softer, and the plantar arches flattened down. Apart from the inconvenience of some degree of chronic nasal obstruction and unsightliness of quite a marked but not disabling degree of flat foot, his general health has not suffered to any degree appreciable to himself. This syndrome began to be common from that time. It was a new one.

As regards the hair, too, the post 1905 period has seen a very marked speeding-up of that loss of the hair which is, we are often told, incidental to civilized conditions. Immediately after 1905 there was a perfect epidemic of falling out of the hair. During the post 1905 period the manufacture and sale of sham hair has leaped up ten-fold. During the same period the natural average head of hair has rapidly decreased in amount. The latter-day fashions of "hogging" the moustache and shaving away the outer portions, etc., marks a sudden failure of the moustache to grow satisfactorily. Such considerations are so impossible to prove, and contain so many sources of error that, perhaps, they weaken rather than help the argument. All these effects of the post 1905 phase are becoming lost. The rising generation is shaking itself free of them.



FIG. 4.—A subject, aged 40, in whom the characteristic 1905 dental deterioration is clearly related to the 1905 etiology. (See text.)

If, however, at the present day you examine either recruits or candidates for commissions in the Army, you will, I think, be struck by the number of young men who are badly anæmic. The percentage is much too high. It strikes one as likely to be secondary to some toxic absorption such as that of bad pyorrhœa or intestinal toxæmia, etc. The former is often excluded.

Again, examining such candidates or recruits, you will be struck by the large percentage who have flat feet to an unsightly degree, though not possibly to a very incapacitating one, at least, as regards hopping and tiptoe tests, which tests certainly, however, permit of incapacitating degrees of flat-foot as a matter of fact.

Suddenly in the past fifteen years there has been a boom in various contrivances to support the arch of the foot. Surgical instrument makers

and ordinary boot shops alike display them for sale all over the country, and a good trade is done in them. In my student days they were very uncommonly worn and never seen displayed for sale in this manner. I have spoken to artists on the subject, and they usually admit that a decently-shaped foot has quite suddenly become much more difficult to find. Apart from all this, there remains the undoubted clinical fact that a sudden change for the worse in the average of the condition of the plantar arch occurred absolutely immediately after the 1905 catarrh in the autumn of 1905. This has become worse with time. As I have mentioned, the new unaccountable type of flat foot in healthy children has been particularly striking, and has affected children of all social grades indiscriminately.

In the above nutritional defects I consider that we see the result of a specific toxæmia related broadly to the post 1905 catarrhal ætiology.

Suppose for a moment that we could compare a group of a 100 children of ages from 5 to 15 years, one group being children of 1900 and the other group children of 1910. We would, I think, be able to notice the following points of difference. In the 1910 group (1) nasal obstruction would be much commoner, and a very large proportion would show some degree of it. (2) A number of the 1910 group would be flat-footed apart from any ascertainable cause; this would be rare in the other group. (3) There would be many more anæmic children in the 1910 group. (4) Comparison of the teeth would just appreciably illustrate the points to which I draw attention. Some of the 1910 children might have some oral sepsis, and few, indeed, if any of the others.

If you substituted a group of 1921 children for the 1910 group, the features would be less noticeable, for we are growing out of the present phase, and, no doubt, its distinguishing features will gradually become more and more lost to view.

There is one important consideration in this connexion which must not be lost sight of. It is that such incidents as the 1918 pandemic, although new to our generation and perhaps new to contemporary memory are not new to the world. The most casual acquaintance with the history of epidemics shows that mysterious and fatal plagues of respiratory illnesses are on record within comparatively recent times. Some of these at least were highly probably "influenzal" in nature and not unlike the 1918 pandemic from all accounts except that they remained comparatively localized in the absence of latter-day facilities for spreading.

In the Dunn-Gordon outbreak in Hertfordshire, in 1905, we have the germ of a plague of infinite potential capacity, and one arising disconnected with anything in the nature of war or national privation. I think, however, that the syndrome of malnutritional symptoms which followed the secondary outbreak (?) related to the Dunn-Gordon one is probably new, and that in the combination of events here suggested, pathology must have uncovered to us hitherto unavailable resources. As to the *modus operandi* I should be inclined to guess that the malnutritional

syndrome may have more to say to the weakened resistance of the catarrhal phase than the 1905 catarrh itself. I think that the long drawn out catarrhal phase is also probably a new phenomenon. It has brought with it a condition of some degree of anarchy in the infective diseases of which the recent pandemic was only one example. I hope to discuss some others on another occasion. The organism isolated in the Dunn-Gordon outbreak was a variety of *M. catarrhalis*.

SUMMARY.

I believe that in the latter part of 1905 either a new disease, or a rare disease in unusually infectious form appeared in this country. I cannot avoid the conclusion that Dunn and Gordon's disease was this as it first appeared and that it lost its more severe characteristics as it diffused until it took the form of the profuse and irresistibly infectious coryza illness which appeared in the London district and neighbouring country in the late autumn of that year.

This infection was of a kind against which the normal immunizing processes were at a chronic disadvantage; hence the irresistible infectiousness and hence the conspicuous failure in resolution. A specific toxic absorption from the nasal mucosa affected the nutrition of at least certain structures.

A slight parody of a degenerative nutritional disturbance resulted widely in the population. The skin and hair lost condition. The teeth became just appreciably specifically stunted and tuberculated. The oro-naso-pharyngeal mucosa certainly shared in the damage. The plantar arch straightway showed a new tendency to give way due to some minor degenerative change in the ligaments supporting it. The above results I premise to be due to the absorption of a specific toxin.

Up to that point I think that this new disease was one entity, i.e., a specific infection giving rise to a specific toxæmia and a specific secondary syndrome of nutritional disturbance.

Grafted on to this were many remote results due chiefly, I have always supposed, to the slight specific degree of damage to the oro-nasal-pharyngeal mucosa (the first line of defence against air-borne infections) and also (?) to some more specific interference with the immunizing process. There followed at once the tendency of infective processes to invade the thus damaged mucous surfaces with the results we have here briefly examined in the light of these opinions. After the silent disaster of 1905, the barriers against air-borne infective disease suddenly began to show a tendency to leak, and since that date the average annual call upon the bodily protective resources of the population have been increased I should guess by ten or even twenty per cent.

REFERENCE.

"An Epidemic Simulating Influenza." Dunn and Gordon, *British Medical Journal*, August 26, 1905.

THE PRINCIPAL DISEASES PREVALENT IN THE RUSSIAN ARMY (CENTRAL GROUP OF THE FRONT) DURING THE PERIOD 1914-1916 AND THE STRUGGLE AGAINST INFECTIOUS DISEASES.

BY PROFESSOR COSTANTINO KRZYSZKOWSKY.

Colonel, Army Medical Services, late Chief Medical Officer at the General Inspectorate of Health attached to the Supreme Command of the Russian Army.

(Concluded from p. 129.)

CHOLERA.

Cholera cases were already reported in the Russian Army during the first months of the war; and from a few isolated cases in November, the disease became a serious epidemic in December which called for urgent and energetic measures to be taken.

The armies which suffered most in consequence of this epidemic were those on the river Bzura (1st and 5th), in a month the number of invalids reached 1·1—1·5 per cent of the total effectives of the Army Group, i.e., about 2,000 cases of cholera in the two armies. Investigations failed to discover the true origin of the epidemic. It had perhaps been imported by detachments of Austrians from Galicia (where there was cholera) sent to support the Germans. On the Bzura, owing to the topographical and climatic conditions (damp, low and rainy respectively) the ground was favourable to the spread of the disease, especially as it had been preceded there by diarrhoeal diseases.

Everything was done to isolate the place whence the infection was spreading. War hospitals were installed in the neighbouring back areas and a "cholera post" organized where all cases of cholera and suspected cholera were concentrated. With the united assistance of the Army Medical Service and the Red Cross, a fairly large provisional laboratory was set up (including three medical officers, medical orderlies and nurses) for the purpose of making a special diagnosis with regard to the carriers of the vibrio; in this way it was possible at once to hold any patient who had been cured, outside the "cholera point" until a repeated examination of the fæces had been made to detect the presence of cholera vibrio. Similar measures were taken by the Union of Zemstvos with regard to the civil population in the posts.

By this means it was possible to localize the cholera epidemic; towards the middle of January, as the cold became more intense, the epidemic began to abate, and could be regarded at an end in March. We are inclined to believe that the cold exercised particular influence with regard to the disappearance of the disease.

The unhygienic conditions prevailing in the trenches played no small part in the outbreak of the epidemic—moreover as the trenches had been

dug in a zone rich in organic refuse. Efforts were made to disinfect it with lime. But nature itself came to the rescue, as the congealed state of the ground dried up the trenches, whilst at the same time preventing the development of the bacteria.

There is no necessity to deal here with measures of a general nature, such as the supervision of the distribution of boiled water and tea, as these have already been mentioned in connection with the struggle against gastro-enteric diseases.

The mortality was not very high (ten to fourteen per cent). During the summer of 1915 there was no cholera epidemic. A few isolated cases, however, were brought to our notice along the north bank of the Vistula, at Ziechanov, Pultusk, and among the forces at Ivangorod and Novogheorghievsk.

Investigations showed that as a general rule the victims were workmen from Galicia. Unfortunately, on the Russian front, despite a good army medical organization, practically no measures were taken to control the hygienic condition of the workmen. They worked and were paid, but no one took the trouble to find out whence they came before they joined the Service, how they obtained their food supplies, and where they lived during the period their work lasted. On repeated occasions we insisted in our reports to the Chief Medical Authorities, on the necessity for strict control with regard to the hygiene of casual labourers. Wherever it was found possible to apply such measures (as for example in the fortified camp of Ivangorod), cholera was quickly overcome.

When visiting the Italian front, we had the greatest pleasure in ascertaining that this idea of hygienic control of workmen had already been put into practice with the best possible results.

The Russian Army was exposed to the greatest danger of all in the summer and autumn of 1915, when cholera made its appearance amongst the Army in retreat and the fugitives from Galicia who followed our forces. Owing to the scarcity of roads contact between the fugitives and the troops was inevitable, and cholera broke out at once in the 3rd Army. We accompanied that Army from Cholm to Baranovichi, and went with the fugitives as far as Kaluga. It would require the pathos of the prophet Jeremiah and the pen of a Dante to attempt even to describe the sufferings of this appalling Calvary. One solitary narrow main road along which moved the troops and almost a million refugees; people who had left their homes already in February and March, and who had concealed themselves in the woods or ditches during the fighting, hoping that they would soon be able to return home. And then a journey which seemed without end, food which was not always of the best and often cold, their nocturnal repose disturbed by enemy aviators who did not scruple to throw their bombs among this crowd of refugees. And in the middle of all this, cholera! All private and military organizations were hastily mobilized. Along the main road were erected surgeries, hospitals, and provisional medical posts—

posts for the supply and distribution of food and fodder for the horses and inns where cold drinks and food could be obtained.

Boilers were distributed here and there along the road in order that the refugees could make use of them to boil water. The isolation of patients was strongly opposed by the local population and not without foundation. In these circumstances the masses of people were constantly becoming separated, and if the refugees left their sick behind in the hospitals, they ran the risk of never finding them again.

This state of affairs lasted up to the end of November when the distribution of most of the refugees throughout the Central Governments (Smolensk, Kaluga) was effected. Luckily the autumn was neither cold nor damp. When inspecting the "high road" to Moscow, the road most frequented by the refugees, it could be gathered from the statistics of the ambulances and hospitals how the organization of medical hospital assistance and the distribution of supplies to the refugees had helped to reduce to a considerable extent the percentage of cases of illness.

Among the troops the struggle against cholera would have been easier had not the fear lest the sick should fall into the hands of the enemy (it had been rumoured that the Germans set fire to the cholera hospitals together with the patients) made it necessary to evacuate the cholera cases, which was a very difficult and dangerous task.

Nevertheless, once more the epidemic was overcome and already began to decrease in September, and disappeared altogether in December. Thus, for example, in September the Army was already more or less isolated and no longer in close contact with the refugees as was the case during the summer months. The maximum amount of cholera cases was 1·5 per cent, the minimum 0·001 per cent, with a 10 to 12 per cent of deaths. It is difficult to furnish any statistics with regard to the mortality among the refugees; however, judging from our own impressions and the data supplied by the medical officers attached to the hospitals and ambulances it would seem as if the mortality did not exceed fifteen to twenty per cent, and that severe cases were the exception.

TYPHUS.

This scourge, which makes its appearance in every war, did not spread very much during this war amongst those groups of forces where the struggle against infectious diseases and the prophylactic measures taken answered the present teachings of science.

In our group, the attention of the Medical Administration, since the beginning of hostilities, was also directed to that of preventing the spread of typhus, against which the best possible measures were taken. The object of their attention was the crowding together of masses of men in the midst of a primitive people and in places scantily inhabited. Following the data of the modern epidemiologist, several remedies were adopted for the destruction of lice. An attempt to make use of ointments carried in packets

on the body to keep the insects away proved of no avail. This may be easily understood when we consider the life in the trenches, to say nothing of the difficulties in providing supplies for an army consisting of several millions of men far from all centres of civilization and barely connected with the few railways available, and difficulties of communication owing to the absence of other main lines of communication and the impossibility of making practical use of the rivers. Finally, more attention was paid to the practice of cleanliness and the value of sanitary precautions was better understood.

Hot water douches or baths appeared to be the most effective remedy. It is a well-known fact that the Russians have the habit of taking baths. In Russia the smallest house, no matter how poor the inhabitants may be, has its bath-room which is invariably used at least once a week (Saturday). Furthermore, the bath cure is a tradition with the Russian peasant, who places great faith in it.

Taking advantage of all this, the medical administration developed the bath system on a large scale. Each unit constructed its own, adapting for this purpose hutments with the result that there was no shortage of baths at the front.

On an average there was a bath of some kind or other to every thousand persons. Frequently there were baths situated at a distance of two kilometres from the trenches; in order that these measures might be thoroughly carried out, special "bath-squads" composed of technical experts and engineers attached to the Army Corps, were formed.

These experts invented a series of different types of baths, easily constructed. They also made successful attempts to organize baths in tents. There was one particular type of transportable baths in the form of two tents the fittings of which were detachable. Good work was done at the front by the squad with the Southern Army Group, attached to one of the Army Corps. A report on the above type of bath was laid before the "Congress of Medical Officers" held at Pirogoff in the spring of 1916 and published in the "*Russkij Vratsch*" in 1916.

This attempt to attach to Army Corps, bath squads capable of constantly supplying baths for large contingents of men, at short notice, is worthy of consideration.

In addition to the above type of transportable baths there were special bath trains which were capable of supplying several hundreds of people simultaneously with baths. These trains were organized by private individuals and private institutions and took up their positions in the back areas of the different fighting groups, according to requirements. Finally, there were baths of a permanent type, established wherever possible (for example in the "evacuation centres," hospitals, line of communication, etc.).

The first epidemic of typhus broke out in one of the reserve battalions in the back areas (near the station of Lida) in the spring of 1915 and later at Warsaw and districts near Warsaw. The percentage of cases

was comparatively small: 0·1 per cent of the total strength. In 1916, there were three outbreaks of the epidemic, the percentage of cases being highest in that of February, 1916 (0·4 per cent).

Investigations showed that the epidemic originated in the back areas and had been brought to the front either by groups destined to complete effectives or by labourers. The precautionary measures taken were confined to isolating the sick and the disinfecting and disinfesting (destruction of insects) of every district where the existence of typhus had been ascertained. In the majority of the cases, the clinical nature of the disease was far different to the serious classical type which causes high mortality.

The percentage of deaths in our Army Group varied between six to ten per cent. Evidently the disease appeared under an attenuated form, perhaps by the attenuation of the virulence of typhus which in 1813 played havoc with Napoleon's Army in these very parts, when the mortality was ninety per cent, the virus of which had settled here since then; this mild form is called "Polski tif" (Polish typhus) and resembles the North-American "Brill's disease" and the Mexican "tabardillo."

There are certain clinical forms of typhus which are so light that they almost pass unobserved—real ambulatory forms.

In our opinion, these are the most dangerous forms from an epidemiological point of view, because they allow the virus time to develop and reinforce itself. Other forms of typhus are often confounded with Eberthian typhoid and the paratyphoid forms; and as a matter of fact in the initial stage of the disease (the rash resembles more measles than petechiæ) the usual light symptoms may result in a wrong diagnosis. The appearance of catarrhal symptoms, however, decide the diagnosis. Very often the rash appeared to be lacking, successful efforts, however, were made to bring it out by obstructing the circulation of blood through the arteries for some time, by means of an Esmarch bandage.

The disease lasted from nine to fourteen days with a temperature of 40—41° C. ending very often with prostration.

The period of convalescence lasted about ten days. A complication which frequently arose was bronchial catarrh or broncho-pulmonary catarrh. Some doctors maintained that the best treatment consisted of strong doses of camphor (Professor A. Ignatovsky).

The laboratories attached to our Army Groups carried out tests in connection with the etiology and epidemiology of typhus, making use for this purpose of the large amount of material available. The tests were completed in the central laboratory of the Red Cross (at Smolensk and later at Minsk) by the Medical Director Buraja and Professor Nidrigailoff; in the military laboratories situated in the "evacuation centres" (Borisov, Bobruisk, Vitebsk, Gomel and the neighbourhood of Baranovichi) and in the transportable laboratory of Medical Administration of the Army Group. The last-named laboratory was composed of three Pullman cars, it was

fitted with everything required for carrying out bacteriological, hygienic and also hydro-biological tests. Travelling along the front, this laboratory served to collect for the other laboratories, rendering assistance when required during periods of high pressure of work, as for example, when an epidemic occurred. In all the above-mentioned laboratories occupied in research work connected with typhus, blood and petechiæ from the sick, the same microbe always stood out, namely, a small diplobacillus, a polymorphic facultative anaërobe whose reaction differed with the use of Gram's solution according to the means employed in its cultivation, this bacillus both on account of its properties and morphologic appearance brought vividly to mind the bacillus described by Dr. Rabinovitsch (Kharkov) who considered it to be the agent of typhus. A similar bacillus was found in typhus by Plotz, Olitzky, Denger and Husch. Nedrigailof and Buraja observed that when placed in bouillon with pieces of the kidneys of guinea-pigs, this microbe developed with great difficulty and very slowly (seven to nine days). Better results were obtained by Dr. Savatieeff who cultivated it upon agar bile, in which case the bacillus assumed a bi-polar appearance. This bacillus was found not only in the blood but also in sections of skin with petechiæ (Davidovsky) in the urine and in the sputum of those suffering from the disease (Savatieeff). An examination of the lice found on the skin of the patients revealed the presence of the above-mentioned bacilli in the digestive passages and the fæces (Krzyzskowsky). Identical bacilli were found by the author in the lice collected in the beds and cells occupied by typhus patients in the prisons of Vitebsk during the epidemic in the autumn of 1916. An examination of the lice found in other cells gave negative results (i.e., absence of bacilli).

Naturally, this research work did not yet solve the question of the etiology of typhus. Nicolle and his school still leave the question open and are rather inclined towards the idea of a filtrable virus. On the other hand, there are sufficient data to prove that if the bacillus described by Rabinovitsch and which was met with on our own front if not the agent of typhus, it must at all events play no negligible part in the etiology of the infection; this is proved by the fact that it is agglutinated with the serum of the patients and finally by experiments upon animals (guinea-pigs) in which it produces symptoms of hæmorrhagic septicemia.

The other authors mentioned above are of the opinion that their bacilli (identical in all probability with that of the Rabinovitsch and that found on the Russian Western front) are agents of typhus. There is a minority in support of Nicolle's theory of the filtrable virus and only very few who maintain that the agent of typhus is a protozoan.

We are unable to supply any further particulars regarding the results obtained in our laboratories from an etiological study of typhus, as the reports on the experiments carried out are not in our possession.

RELAPSING FEVER.

Relapsing fever made its appearance in 1916 in the form of an epidemic in which the number of cases reached the maximum of 2·5 per cent of the total strength of the troops. Similar to typhus it was brought to the front either from the back areas or by the prisoners over whom it was impossible to exercise any kind of strict medical supervision, especially when they arrived in large crowds as was the case during Brussilov's advance in Galicia in May, 1916. In other respects the epidemic of relapsing fever was not contagious nor difficult to overcome.

DYSENTERY.

A few slight cases of bacillary dysentery occurred, some of the Shiga-Kruse type and others of the Flexner type according to the regions. The infection almost invariably originated from water as was shown by the fact that in several cases the specific bacilli were found in spring water analysed in the laboratories at the front. Like the other infectious diseases, dysentery appeared during the first months of the war and in 1916, the percentage of sick cases amounted to 6·5 to 7 per cent. The object of the epidemiological measures taken was to see that the units were supplied with pure water and to disinfect the units affected by the disease.

There is no necessity to dwell here upon other infections such as diphtheria, scarlatina, measles, smallpox of which there were only a few isolated cases.

SCURVY.

In conclusion, we desire to say a few words about scurvy, a disease which, although not coming under the category of infectious diseases, produces nevertheless in war time the same effect of increasing ineffectives. During the first months of the war there was not a single case of scurvy in our Army Group. It did not appear until the summer of 1915, the maximum number of cases being from eight to nine per cent in the summer of 1916. The percentage of cases was greater in the Armies on the Southern front and Roumanian front where more than 10,000 cases of scurvy were reported in the summer of 1917.

Observations on the development of the scurvy epidemic are interesting from the point of view that they supply a certain amount of data regarding the cause of this disease, the origin of which remains obscure. It is maintained for example that food of a uniform nature and the absence of pulse and fresh vegetables are one of the principal causes of scurvy (the well-known theory of the vitamine). Nevertheless there were units in the Russian Army (Roumanian Group) among whom green vegetables were distributed in sufficient quantities and yet scurvy was very prevalent. But in the Armies of our Group (Western) the green vegetables were not insufficient everywhere and the rations during the summer of 1916 as we

ourselves were able to observe during the frequent inspections were neither insufficient nor uniform. It should perhaps be remembered that the damp and marshy soil was not without influence on the appearance of the epidemic, a further cause being the state of physical depression of the troops. The first enthusiasm had died down (we do not allude now to the period of 1916-1917) the effectives were no longer composed of very young men, but for the most part men over 30 years of age, taken from their homes and families and suffering from home-sickness; then the reverses of 1915, the period of inactivity in the spring of 1916 and the long periods of immobility in the trenches were all factors which could not but affect the moral of the troops reacting in turn upon their normal nutrition and constitution. This in our opinion was a favourable soil for the easy development of scurvy among the Russian troops during the third year of the war.

The struggle against this disease, based on all the prevailing ideas, consisted in an improvement of the food-supply and the distribution of vegetables and vegetable extracts on a large scale. But in addition to all this it was found that the draining of the trenches and ventilation of the tents proved to be the most practical means for bringing about a decrease in the disease. However, good results were obtained by concentrating all the scurvy cases in special camps situated in dry places in the midst of pine forests where the patients, with better nourishment and light manual labour, were cured in a comparatively short time. The chief medical officer of one of the divisions protected his troops from scurvy by subjecting all the weak and suspect cases to a medical examination and dispatching them to a special camp situated in a hilly district in the back areas and keeping them there for some time. There only occurred a few sporadic cases of scurvy in this division. It is evident that the following appears to be the only rational means: to keep under observation men of weak constitution suffering from mal-nutrition and without waiting for the appearance of more important symptoms, sending them to places where their condition could improve. It is absolutely necessary that all troops showing symptoms of hemeralopia (fore-runner of scurvy), and whose gums show even the slightest signs of hæmorrhage when pressed lightly, should be given rest.

CONCLUSION.

In conclusion, we append figures showing the maximum and minimum number of cases in respect of each of the more important diseases. The number is calculated per thousand of the total strength.

			Minimum		Maximum
Cholera	0 (1916)	16 (1915)			
Dysentery	0 (1916)	65 (1916) July			
Enteritis	10 (1916) Jany. to April	90 (1915) Jany.			
Typhoid fever	2 (1916) May-June	23 (1914-1915) Dec.-Jan.			
Typhus	0.5 (1914)	4 (1916) Feb.			
Relapsing fever	0 (1914)	26 (1916) Feb.			
Scurvy	0 (1914)	80 (1916) July			

206 *The Principal Diseases prevalent in the Russian Army*

A glance at these figures shows that the highest percentage of sickness occurred in 1916, i.e., in the third year of the war. Evidently physical lassitude had weakened the organic resistance of the troops rendering them liable to catch the different diseases. On comparing our own statistics with the data published up till now regarding the cases of sickness in the British and French Armies, it must be said to the honour of the Russian medical officers that the latter acquitted themselves of their duty no less honourably than their colleagues of the West in spite of the fact that the means at their disposal were infinitely more restricted and that their work had to be carried out under far more unfavourable conditions.

THE DUTIES OF A DEPUTY ASSISTANT DIRECTOR OF MEDICAL SERVICES AT THE PRESENT DAY.

BY CAPTAIN H. G. WINTER, M.C.

Royal Army Medical Corps, Deputy Assistant Director of Medical Services, Egypt.

WE are still, to a greater or lesser extent, experiencing a period of transition from war to peace, a period of reconstruction. It therefore follows that the duties of any officer holding an Administrative appointment are constantly changing with the prevailing conditions, and no hard and fast rules can be laid down.

The duties of a Deputy Assistant Director of Medical Services may be briefly summarized as follows :

(1) He is Staff Officer to the Assistant Director of Medical Services or Deputy Director of Medical Services.

(2) He is responsible for the office routine, the correctness of returns, the drafting of orders, etc., and must be *au fait* with all Orders and Regulations.

(3) He is guide, mentor and friend to all junior officers in the area in the matter of regulations and procedure.

The qualities necessary in a successful Deputy Assistant Director of Medical Services are, absolute loyalty to his Assistant Director of Medical Services, unfailing tact, a knowledge of human nature, an active and judicial mind ready to grasp the salient features of a problem, an intimate and extensive knowledge of regulations, routine, and procedure, a good memory and, last but by no means least, a vast capacity for hard work.

A Staff Officer of the Corps should have held the appointments of Officer in Medical Charge of Troops, Registrar and Company Officer, and should have served in a field ambulance, because by so doing he gains an intimate knowledge of corps duties, and can appreciate the difficulties of officers in the area. He should, moreover, have an extensive knowledge of Quartermaster's duties, as this enters into a large part of the work with which he is called upon to deal ; he must know how to keep an ordnance ledger correctly, how to keep a diet account, where and how to indent for such articles as medical comfort panniers, stretchers, glass for broken windows, cresol, spare wheels for horsed transport, etc. Each officer of the Royal Army Medical Corps should avail himself of every opportunity of learning Quartermaster's duties : he may be a Commanding Officer with a good Quartermaster on his staff to make things smooth for him, but his next unit may be one to which no Quartermaster is attached and, if he does not know something of these duties, he is entirely in the hands of his non-commissioned officers.

A knowledge of corps duties, however extensive, is not sufficient. The Deputy Assistant Director of Medical Services must therefore assi-

milate a knowledge of the duties of other branches of the Staff, and of those of the directors of other departments of the Army.

Tact, as stated above, is essential both in dealings with members of the Staff and departments, and with officers of the Corps. As a junior officer he is called upon to exercise tact and firmness in dealings with senior officers of the Corps in the area; tact, because he gains nothing by an exaggerated idea of his own importance and may easily unwittingly give the impression that he is presuming upon his position; firmness, because he must always be loyal to his Assistant Director of Medical Services and, though asked, he must remember that he is not in a position to promise anything except on the authority of the Assistant Director of Medical Services.

There are three types of Staff Officers; the one is the officer who is excessively polite and kind, and will promise anything that is asked, but who does nothing that he has promised unless it does not interfere in any way with his plans; after an interview he leaves the impression that he is an extraordinary good fellow and will do anything for one—he is, in fact, an accomplished liar. The second is the bluff, rugged type who, when he says "Yes," means it and will do what he says, but if he cannot do it says "No" and there the matter ends—he is not always polite. The third, and ideal type, is in an intermediate position between the two; he is kind and polite but firm, he has every sympathy with the difficulties of the petitioner, but if it cannot be done he politely but firmly says "No," and sticks to it; moreover, he does not "Rob Peter to pay Paul." Because a Commanding Officer comes to him and asks for a certain non-commissioned officer, who is doing duty at another hospital, although that Commanding Officer may give very good reasons for the transfer of the non-commissioned officer to his unit, he will not promise to transfer him unless he is of opinion that the man is not employed to the best advantage at his present unit and that his transfer would not cause serious dislocation of work, and that it is in the interests of the Service.

A Staff Officer of the Corps must know all Royal Army Medical Corps Officers, senior non-commissioned officers and as many rank and file as possible in the area, and must be able to make a quick and accurate estimate of their character and idiosyncrasies. He should be intimately connected with the life and sports of the Corps generally. It is better, however, if he is a bachelor, that he should not live in the Royal Army Medical Corps Mess, because he must be scrupulously fair in his dealings, and however careful he is, he lays himself open to charges of favouritism to the unit with which he is living.

Knowledge of regulations and procedure is largely a question of experience and an officer should never neglect opportunities to improve himself in this respect. In the course of a day's work he is called upon to deal with a large and varied amount of correspondence embracing a vast range of problems. If he does not know where to find the question

at issue dealt with in Regulations or to which department to refer it, he will waste much time and will get behind in his work—a fatal error to commit. Further, a Deputy Assistant Director of Medical Services, who is constantly asking for information which he should be able to supply himself does not go up in the estimation of the Assistant Director of Medical Services, nor will the latter be pleased if he is constantly asked to sign or forward communications, etc., which are inaccurate or incomplete.

As in all other duties, a good memory is essential. A Deputy Assistant Director of Medical Services is frequently having questions and orders fired at him in the middle of a busy day's work, and in Staff duties no detail must be neglected, and no important facts forgotten. It is obviously a fatal error to issue contradictory orders or rulings. It is, moreover, humiliating when, in telephonic conversation, a Staff Officer is asked about a certain matter and states that he knows nothing about it, although the officer asking the question has the very subject dealt with in a memo lying on the table in front of him and signed by the Staff Officer at the other end of the line. It is no excuse to say that he was very busy the morning he signed it.

The "Gilded Staff" have, quite undeservedly, the reputation of having a very soft time and doing little work. This is far from being the case if the officer is doing his work properly. A Staff Officer has got to work and go on working, he must be prepared to work up till long past his lunch time in the morning, and frequently has to take involved or long items of correspondence with him so that he can work at them in the quiet of the evening at home—if he is married, much to the annoyance of his wife. Disbandment Orders for a Unit, short and concise opinions on the findings of Courts of Enquiry, Royal Army Medical Corps Instructions in connexion with Defence Schemes look nice and simple when issued but they mean a lot of hard work, and their very simplicity requires a deal of careful thought and consideration. No details, however small, must be omitted, and no possibilities overlooked.

As Staff Officer to the Assistant Director of Medical Services, the Deputy Assistant Director of Medical Services, can do much for the comfort of his chief and should anticipate his wishes. He should keep a diary in which he notes the proposed future or the past movements of the Assistant Director of Medical Services, inserting *times* of arrival and departure and numbers of railway warrants, etc.

If the Assistant Director of Medical Services decides to inspect a unit or an area, the Deputy Assistant Director of Medical Services must make all arrangements beforehand; he must arrange for cars, when necessary, and must not forget to provide railway warrants, note book and pencil, etc., and also notes as to the recent happenings with regard to the unit to be inspected and any points which require special notice at the inspection. He should notify the Officer Commanding unit as to the

time of arrival, and ask him to ensure the Assistant Director of Medical Services being met; he should make out draft orders for the inspection and get them signed by the Assistant Adjutant and Quartermaster General.

These orders, together with the information inserted in the diary, as to times, etc., will be required for the compilation of claims for travelling and detention allowance on the return of the Assistant Director of Medical Services.

After an inspection, the Staff Officer will, from the notes made by and under the instructions of the Assistant Director of Medical Services, draft inspection notes, and will draft and dispatch such memoranda as may be required. A convenient form for these inspection notes is as detailed.

"Notes on the inspection of.....Hospital, by ColonelA.D.M.S.
.....on....."

Points observed.

Action to be taken.

A copy of these notes will be shown to the next inspecting officer.

Colonel."
A.D.M.S.....

The responsibility for office routine, etc., is by far the larger portion and the most important duty of a Deputy Assistant Director of Medical Services. He must run the office himself and know every detail, he must not leave the greater portion of the office routine to the head clerk. He must draft all but the least important of the memos. himself, and if he does not draft the latter memos., he must pencil on the correspondence orders as to disposal. He should see all the incoming correspondence, and should shew all matters of any importance or any question requiring a ruling to the Assistant Director of Medical Services, and receive his instructions as to their disposal. In the absence of the Assistant Director of Medical Services on inspection duty, etc., he will deal with more than he would in the ordinary course; but even then, he should lay aside all matters which are not urgent and on which the Assistant Director of Medical Services should give his ruling.

All memos. addressed to higher formations and all memos. containing any form of censure must be signed by the Assistant Director of Medical Services. The Deputy Assistant Director of Medical Services, should as a general rule, only sign the more trivial items of correspondence.

It is a good plan to cause all office files of correspondence dealt with during the day, to be put together in a jacket and left in the office for one day before they are finally filed away. This allows all officers working in the office to keep in touch with all that is going on.

A useful book to read on the subject of office work is "Guide to Official Correspondence and Letter Writing." Gale and Polden.

Registration is one of the most, if not the most important function of

of an office, and one of the best clerks should be detailed for this duty. The author is firmly of opinion that in none but the smallest military offices, such as a reception station, should the archaic system of book registration be used. In an office of any size, it is a matter of great difficulty, even if the register book has been kept properly, to find correspondence that occurred at any long period previously. Clerks, even the best, do not keep up the index properly, and looking through several old registers is a tedious and heartbreaking job, and it is practically useless if the office staff has changed since the registers in question were in use. In most, if not all headquarter offices, there is a central registry, but even if a registry is present, the Assistant Director of Medical Services office requires some sort of registration.

The only efficient, cheap and labour-saving form of registration is the Card Index System. The writer has been using a simplified form of Card Index Registration for over a year with complete success. Far less time is taken over registration than with the book system, and any subject can be looked up in a few minutes even if it occurred a year ago or more. The card is a register and index combined. If the register clerk becomes a casualty, another can take over the duties at once. An extremely simple and efficient "bring forward" system is embodied in the scheme by which a steady flow of "reminders" is ensured and no questions are left unattended to.

A detailed description of the system is hardly within the scope of this article, and it is proposed to make registration in military offices the subject of another article.

There are a large number of officers who appear to look upon all returns as being useless forms specially invented by our beaurocratic government for their personal annoyance, and are very hurt when inaccuracies are pointed out to them. If these officers would only take the trouble to study the instructions for the rendering of these returns, and comply with the notes printed in most cases on the forms—in fact, if they would only take an intelligent interest instead of leaving the compilation to their clerks—they would find that returns are not such formidable, purposeless documents as they first supposed. The author can testify from first-hand experience in the compilation of the most intricate returns, such as the Army Form B. 104-139, which was the bane of the Company Officer's existence during the late war, that none are so difficult as to afford an excuse for inaccurate submission. Plain commonsense, a thorough mastery of the instructions and reasonable care are all that is required.

The Deputy Assistant Director of Medical Services can do much to make the work of officers rendering returns easy. He should thoroughly master every detail of these returns and he will soon learn by experience what are the points which cause most trouble. He should draft detailed instructions to be circulated to units in order to assist them in com-

piling the forms. These instructions, if they are to be of any practical use, must necessarily be rather long, but they are very valuable documents if carefully and clearly written, in that they explain the existing regulations and ensure a uniform interpretation of them and consequently a uniform method of compilation of the returns throughout the administrative area.

Long and detailed instructions are specially necessary with regard to the Army Forms A.31 and A.31a.

A Deputy Assistant Director of Medical Services should always be on the look out for any means whereby he can reduce the number or simplify the compilation of returns. He should work on the principle that manuscript returns should be scrapped and existing Army Form returns made to do their work. He should constantly study returns, and if he can see a way to cut out a return by making another do its work, he should immediately put the case to the Assistant Director of Medical Services for his opinion, and if he concurs, reference to higher authority if necessary. No Staff Officer should ever institute a new return without first carefully considering whether he could or could not, possibly with a slight amendment, make an existing return give him the required information. He should also consider whether the extra work placed on units is justified by the result.

If the Deputy Assistant Director of Medical Services will keep up a simple card index of all officers in the area, a card for each officer showing all particulars required, and if he ensures an efficient system for the reporting of casualties, there is no need for units to render such returns as Army Forms B.149 and C.340, etc., as consolidated returns can easily be rendered from the Assistant Director of Medical Services office without reference to units.

It is sometimes found that units are rendering and the Assistant Director of Medical Services forwarding in consolidated form returns which have been "nil" for a considerable period, and are quite obsolete. For instance, an outbreak of mumps occurs in two or three units, and the Assistant Director of Medical Services calls for a weekly return of cases of mumps. It is quite easy for that return to continue for a year or more—long after all necessity for it has ceased. A carefully compiled list of all returns should, therefore, be kept in the Assistant Director of Medical Services' office, and the Deputy Assistant Director of Medical Services should constantly go through this list and revise it from time to time, always with a view to reduction.

It would take up too much space in this article to detail some of the commonest faults made in the compilation of individual returns, but the majority of errors are due to carelessness, and result as a rule from the fact that the work is left to a large extent to inexperienced clerks, and is only checked in a perfunctory manner, if at all, before being signed.

It must be remembered that it is the officer who signs a return, and not

the clerk who compiled it who is responsible ; moreover, it is unfair to the clerk who is being given the work of the officer as well as his own.

There are, of course, clerks and clerks, but all work better if they realize that the officer who signs the correspondence knows more about it than they do, and if they know that he has an uncanny knack of placing his finger on inaccuracies. It is realized that the material at small out-stations, and in some cases even larger units, is not always too good, but if the officers of the units have a thorough knowledge of their clerical duties, they can train their office staffs to be at least accurate. This means constant supervision and painstaking instruction.

It has been stated that an officer can best be judged by the character and work of his subordinates ; this is most true in respect of clerical work. An officer can be judged very fairly and accurately by his office staff, and the work turned out by his office. Some officers are run by the office staff, some run the office, and a few run it efficiently.

If an office is run efficiently, all ranks will take a pride in the work turned out, and will strive to maintain or improve on the high standard reached. If the officer takes an interest in the work, he is, moreover, continually learning ; this is specially the case if he has the luck to have an experienced and efficient head clerk.

The head of the office should be able to go away for a time with an easy mind if he knows that routine is being carried on in an efficient manner by the head clerk in his absence.

If an administrative officer takes an intelligent interest in returns and understands them, he can get a great deal of information out of them regarding his area. The Army Form A.27 is a particularly useful return, and these forms from each hospital should be studied daily by the Assistant Director of Medical Services and the Deputy Assistant Director of Medical Services. If this is done conscientiously, a great deal of useful information regarding the health of the troops in the area, etc., will be gleaned.

The great trouble about returns is that because they are rendered as a routine, they are liable to be simply checked and then p.a.'ed. Those to whom they are rendered do not, as a general rule, make sufficient use of them. A great deal of unnecessary correspondence would be avoided if administrative officers would make a more careful study of routine returns. It is quite unnecessary, for instance, to write to hospitals and ask for a return of the number of cases of venereal disease admitted during the month, as this information is given in detail by diseases and average daily sick of units in A.F. A.31. It should not be necessary to ask for any information as regards sick if A.F.s A.31, A.31a and A.27, and the monthly sanitary reports are studied in an intelligent manner.

All Medical Boards, Courts of Inquiry, Boards of Survey, etc., must be carefully checked personally by the Deputy Assistant Director of Medical Services before being disposed of. It must be remembered that the value of these can usually be assessed in £ s. d., and that hardship may be

inflicted or injustice done as a result of inaccuracies in the proceedings, which may have escaped notice. All orders and instructions issued by other branches of the staff and all notifications regarding movements of troops, policy, training, etc., must be carefully read, with a view to ascertaining how far Royal Army Medical Corps units are affected, or whether any medical arrangements are required.

It is laid down in Field Service Regulations, Part II, that one of the duties of a Staff Officer is to give the troops every assistance in his power in carrying out instructions issued to them. In the author's opinion this is one of the most important duties of a Deputy Assistant Director of Medical Services. When drafting minutes, forwarding items for action and in issuing orders he should endeavour to put himself in the position of the officer who has to carry out the instructions, and should, where necessary, amplify these instructions with explanations, etc., in order to eliminate as far as possible every source of error, and to simplify matters for the recipient; he must not be discouraged in his efforts to help by the fact that his instructions do not always appear to be carefully read; it is quite possible, and, in fact, probable, that in many cases failure to carry out the instructions in the way they were intended is due to want of clarity on the part of the writer.

An officer writing any orders or memos. should always read them over himself after writing them, and look at them from the point of view of the recipient. He should also get someone to read them over and interpret them to him. Orders should be clear, concise, as short as possible, and couched in short sentences and paragraphs, and carefully spaced. They should contain all the information that is required, and every detail should be anticipated, but no extraneous matter inserted. Explanatory details should be in the form of notes or as a separate memo.—very little if any explanation should be required if the orders are carefully framed, and no ambiguous terms used.

There is a certain type of individual in the Army who reads orders very carefully, with a view to finding ambiguities or loopholes, and wonders "How can I best evade these orders?" There is yet another type who reads orders rapidly and gets a general impression—usually wrong—and, perhaps, a few details that have caught his eye—usually trivial. The writer of orders must endeavour to cater for both these types; he can safely leave the average common-sense man to interpret the orders and comply with them correctly. He can checkmate the first type by writing his orders very carefully, and the second he can endeavour to cope with by careful spacing and well thought-out headings.

The Deputy Assistant Director of Medical Services should compile and submit to the Assistant Director of Medical Services for approval and issue, explanatory instructions in procedure; this specially refers to the routine procedure for Medical Boards, duties of Officers in Medical Charge of Troops, compilation of A.F.s A.31, A.31a, I.1220, I.1237, I.1209, etc.

This involves a lot of work, and reference to many books of regulations and orders on the subject, and a great deal of care and thought ; but it is well worth the labour in that it is of great assistance to officers, and saves them the trouble of worrying out the problem for themselves. If these instructions are well written and carefully read, a great deal of correspondence will be avoided, and eventually the work of the Deputy Assistant Director of Medical Services lessened.

The Army, like all Government departments, is extremely beaurocratic ; the nearer, therefore, that office work can be reduced to machine-like precision and everything done by routine, the better will the work be done and the less worry and anxiety caused. It is with this end in view that the instructions mentioned in the preceding paragraph should be issued.

Owing to the lack of time and facilities for professional work, the appointment of Deputy Assistant Director of Medical Services should be for a limited, and not too long a period.

There are some officers of the Corps who are inclined to increase their military and administrative at the expense of their professional knowledge ; others are inclined to neglect the military and administrative side and concentrate on their profession. Both are at fault. An officer of the Royal Army Medical Corps is first and foremost a doctor, but he is also a Commissioned Officer in his Majesty's Army, and must perform the duties of an officer. It should be easy for an officer of the Royal Army Medical Corps, by reason of his early training and education—many of them are University graduates—to compete in military and administrative matters with the best brains in other branches of the Service, without neglecting their professional duties.

All junior officers in the Corps should, therefore, endeavour to obtain administrative appointments, and, after they have thoroughly mastered the detail, should apply to be relieved and to be posted to a unit for duty where they can revise their professional knowledge.



Clinical and other Notes.

NOTES ON A CASE OF ANEURYSM OF THE BASILAR ARTERY.

BY CAPTAIN E. W. WADE, D.S.O.

Royal Army Medical Corps.

SERGEANT-MAJOR L., aged 46, was admitted to "Tower Hill" Military Hospital, Sierra Leone, in July, 1921, complaining of headache and loss of vision. There was a history of otorrhœa in the left ear in 1916. No history of syphilis, but the patient had had gonorrhœa twenty-six years previously.

Seven months before admission he had noticed difficulty in walking straight, staggering to the right every few yards; the condition became worse and he began to have headaches which lasted two or three days at a time.

The pain was most severe at the back of the skull and radiated to the eyes and ears.

Three or four months before admission his speech became slurring and indistinct, and about three months before admission his vision became hazy, being worse in the left eye.

On admission he was seen by Captain T. L. Fraser, O.B.E., R.A.M.C., whose notes on this case I am taking the liberty of publishing.

"General condition poor. Headache still present, occurs in spasms and is hemalgic in character. Point of maximum intensity below the occipital protuberance. Proptosis of left eyeball present. Pupils are unequal, left bigger than right. React slowly to light and accommodation. Left more sluggish than right. No facial paralysis. Dryness of mouth and throat. Speech slurring and indistinct. Ringing present in left ear. Knee-jerks exaggerated, left more than right. Staggering gait, patient falls to right. Cannot stand with both eyes closed. Is not able to walk along a straight line. Enlarged prostate. Daily catheterization necessary. Hæmorrhoids present. For some time has had some difficulty in micturition, frequency and dribbling. Patient eats and sleeps fairly well."

He was invalided to the United Kingdom as a right-sided cerebellar tumour. Admitted to Military Hospital, Devonport, on February 6, 1922, when I saw him and his condition was as follows:—

"General condition poor, headaches still present occurring in spasms with point of maximum intensity below occipital protuberance. Temperature, normal. Pulse 88 to 100. Respirations 18 to 20. Intelligence good, speech slurring and indistinct. Memory for old events good, for recent events not so good. There was no actual paralysis but the right arm and leg were slightly weaker than left. No facial paralysis. No anæsthesia to light touch, pain, heat or cold anywhere over trunk or limbs. Gait rather spastic, especially right leg; drags right foot and always deviates to the right. Pupils very small, equal, re-act to light and accommodation, nystagmus fine to right, coarse to left. Knee-jerks exaggerated especially right. Plantars, right flexor; left not obtainable. Patellar clonus marked on right side, none on left. Ankle clonus marked on right side, none on left. Sphincters normal, no incontinence of urine or fæces. Difficulty of micturition

from enlarged prostate. There was nothing abnormal in the remaining systems. Urine acid, 1010; albumin, nil; sugar, nil. Blood count showed hæmoglobin eighty per cent. Red corpuscles, 5,100,000; white corpuscles, 10,800; polymorphs, 79 per cent; lymphocytes, 15.5 per cent; large mononuclears, 4.5 per cent; eosinophiles, 0.5 per cent; mast cells, 0.5 per cent. Wassermann reaction was negative.

Cerebrospinal fluid showed no trace of globulin, no lymphocytes and no sugar. Wassermann reaction negative. The cerebrospinal fluid was not under increased pressure.

An examination of the ears by the aural specialist showed "definite signs of old inflammation of both ears, especially left. Membranes are both much retracted. No evidence of any active suppuration in either ear. Hearing much reduced in left ear."

An examination of the eyes by the ophthalmic specialist showed "no optic neuritis in either eye; this rules out cerebellar tumour as optic neuritis is an invariable accompaniment of cerebellar tumour; the fundi are normal in every respect."

The surgical specialist did not think an operation advisable as there were no localizing symptoms nor optic neuritis. After admission patient remained *in statu quo* until February 24, when all his symptoms increased in severity and he had difficulty in swallowing, which became worse, necessitating nasal feeding. He died on March 2, 1922, approximately fourteen months after the appearance of his first symptoms.

At the autopsy the following condition was found. Brain and membranes congested. Aneurysm of basilar artery about the size of a bantam's egg and involving the circle of Willis. It had caused pressure on and indentation of the pons varolii, medulla oblongata, temporosphenoidal lobe and cerebellum on the left side.

It is interesting to note how the symptoms on the right side changed from those of an irritative lesion to those of a destructive one.

SOME HINTS ON THE SANITARY EQUIPMENT REQUIRED FOR A BRITISH TRAINING CAMP IN INDIA.

BY CAPTAIN J. BRYAN FOTHERINGHAM.

Royal Army Medical Corps.

A JUNIOR Royal Army Medical Corps Officer, new to India, and with no previous service in the East, in most cases will find difficulty in arranging what sanitary equipment the battalion of which he is in medical charge, should take to an Annual Training Camp. The camp site chosen may be at a place which will render it possible for him to visit it beforehand. Often it is quite impossible for the Regimental Medical Officer to examine the camp site chosen prior to going there with his regiment. In that case he has to rely on second-hand information about the local water supply, the presence or absence of incinerators, the diseases prevalent in the locality of the camp, and all geological and topographical details.

In practically all instances he will be given an accurate and sufficient account of these matters by the A.D.M.S. or D.A.D.M.S. (San.) of his district through his commanding officer.

In addition, he will be instructed to arrange direct with the Officer Commanding the Regiment of which he is in medical charge, that the Battalion takes a sufficiency of :—

- (a) Incinerator bars of a standard length and diameter.
- (b) Urine funnels.
- (c) Latrine pans for five per cent. of the total strength.
- (d) Kerosene oil tins to act as night urinals, refuse tins, etc.
- (e) Screening for latrines and urinals.
- (f) Head cover for cookhouses.
- (g) Cresol, crude oil, kerosene oil, and lime, according to scale.

Finally, he will probably be told that all drinking water at the camp must be chlorinated, that his unit must carry out incineration of fæces and all camp refuse, and that the burying of such matter must not be sanctioned.

To the Royal Army Medical Corps Officer with previous experience of British Training Camps in India, such instructions as given above are sufficient. His previous experience enables him to make a list of sanitary equipment which will approximately meet the demands required.

It will perhaps benefit some Medical Officers if a more complete scale of suitable sanitary equipment is herein given, with a few remarks on the actual use of such equipment.

Before interviewing the Officer Commanding Battalion, it is advisable to make out what the Regimental Medical Officer considers a satisfactory scale of sanitary equipment, based on the actual strength of the unit proceeding to camp.

The scale given below is for an Infantry Battalion of the following strength :—

British Officers	20
British other Ranks	700
Indian Troops, Indian Contractor's Employees, Officers' Bearers, Syce and Sweeper personnel, etc.	100
Horses and Mules	160

It is worked out on the principle that the troops are to be trained under Active Service conditions, and that the transport available for sanitary equipment is limited.

The requirements for a fourteen to twenty-eight days' camp are as follows :—

18 kerosene tins for night urinals. These should be previously inspected to see that all are water-tight, and should be provided with wire handles to facilitate their removal when in actual use. This number covers the night urine tins required in the neighbourhood of the canteen and Officers' mess, in addition to these required round the camp.

18 kerosene tins for cookhouses, with 5 Company cookhouses and 1 Officers' cookhouse, this allows 3 tins per cookhouse, 1 to finish off the cookhouse grease-trap and 2 as refuse tins, 1 for wet refuse and 1 for dry refuse.

12 kerosene tins for the storage of ablution water. These should be provided with wire handles and kept filled beside the ablution bench; they are, of course, not necessary if there is a stand pipe in the proximity of the ablution bench.

6 kerosene tins as refuse tins. These are for use in the neighbourhood of the officers' mess, coffee shop, and other regimental institutes.

2 kerosene tins for use in the camp hospital; 1 for soiled dressings and 1 for reserve water for hospital ablution purposes.

4 kerosene tins for use as follows: 1 as a urinal in guard tent; 1 to place over the soakage pit at the Indian "abdust" place; 1 to form an additional urinal for Indians; 1 to cover the soakage pit for night urine disposal.

27 wooden fly-proof lids for kerosene tins used as follows: 18 for the 6 cookhouses to cover grease-traps and refuse tins; 6 to cover the refuse tins at the officers' mess, regimental institutes, etc.; 1 to cover the Camp Hospital refuse tin; 1 to cover the tin over the night urine disposal pit; 1 to cover the urine tin in the guard tent. These lids should be made with short sides and lined with sacking. A strip of leather or rope nailed on top makes a convenient handle. The lids are very satisfactory and can easily be made at small cost by the regimental pioneers before proceeding to camp. They must be close-fitting.

35 latrine pans for the 700 British other ranks—any pattern will suffice, and cut-down kerosene tins answer the purpose.

3 folding commodes for Officers, should be supplied with zinc latrine pans, or fitted with improvised tin pans.

10 latrine pans for Indians: 2 to each latrine if carrying out the 2-pan system; 5 latrine pans required if using the 1-pan system (as on the scale for British other ranks).

Latrine screening for officers, non-commissioned officers, men and Indians. Sacking with bamboo poles will suffice.

24 iron incinerator bars. These should be about 4 feet 6 inches long and $\frac{5}{8}$ inch in diameter. This number is enough to make 2 open mud and stone incinerators of an internal diameter of 3 feet 6 inches. It is a generally accepted fact that this type of open incinerator is capable of dealing adequately with the faeces and rubbish of 200 men. It is advisable to make 4 incinerators of this size and pattern, if not 5. This allows of 1 incinerator being out of action for repairs or cleaning, and also allows of the incineration of any additional horse or mule litter. In order to make bars for the additional 2 to 3 incinerators, platforms should be made of interlacing broad "bhoosa" wire in a criss-cross fashion. The advantage of this is that on the day the unit leaves camp, it is only necessary for 2 incinerators to be dismantled, in order that the Quartermaster may load his iron incinerator bars. Broad "bhoosa" wire is readily procured, and is useful for other purposes such as fixing up latrine screens, etc.

30 strands of broad "bhoosa" wire should therefore be taken to camp.

6 urine funnels for use in day urine pits are required; 4 to place in the urine pit for men; 1 for warrant officers and non-commissioned officers; 1 for officers' urinal. These urine funnels are usually cone-shaped and of the following dimensions: 4 feet 6 inches long, 6 inches in diameter at the mouth, and 2 inches in diameter at the lower end. They can easily be made by the regimental pioneers from old kerosene tins, prior to the unit proceeding to camp. They cost about 1 rupee each.

1 riddle for litter.

2 wooden rakes for turning over litter on litter-drying areas.

4 sheets of corrugated iron to make a rough ablution bench and wooden struts to support the bench.

22 sheets of corrugated iron to make field ovens for the 6 cookhouses.

100 sand-bags for posting in camp to collect dry refuse.

1 white flag for denoting men's drinking water.

1 blue flag for denoting animals' drinking water.

1 red flag for denoting ablution water.

1 yellow flag for denoting the conservancy area.

These flags must be provided with the necessary poles, ropes, etc.

Sign-boards for latrines and urinals for officers and other ranks.

Toilet paper (an issue from the Supply and Transport corps).

Overhead screening for cookhouses should be taken to camp. This screening and the latrine screens are usually arranged for by the regimental quartermaster.

2 maunds of cement. This is very useful for finishing off grease-traps, "abduct place," night urine disposal pit, etc.

10 maunds of lime. Its chief use is to put a finishing touch to the completed sanitary appliances.

Creosol, crude oil, and kerosene oil. The full scale allowed for the camp period should be taken, and also bamber oil as a mosquito deterrent.

1 "Horrocks's box" for water testing.

Bleaching powder in the quantity arranged for by the D.A.D.M.S. (San.).

So far no mention of a bathing establishment for troops has been discussed. If there is no suitable stream which can be dammed in order to make a bathing pool, it is advisable to take one or more improvised shower baths. A pit in the ground, lined with tarpaulin, is not satisfactory, and uses up a large quantity of water. These shower baths can be made in the regimental pioneer shop before proceeding to camp. A good example of this type of bath is shown on p. 310 of Field Service Sanitary Notes, India, 1919. It costs about 30 rupees to make, and takes 2 men half a day to put together in camp and get ready for use.

No mention is made in this article on latrine seats or "back rests" for British troops' latrines. If taken to camp they add greatly to the total amount of sanitary equipment carried, and are not essential. Again, the alternative method of using urine funnels in place of night urine tins is not suggested. In a temporary camp night urine funnels are not necessary. It takes a considerable time, and numerous fatigue parties to dig the pits for grease traps, day urinals, etc., and the camp period would be almost over by the time several night urine soakage pits were dug and properly fitted with funnels, etc. Finally, no mention is made on the supplying of portable latrines for night use as in a perimeter camp on the North-West Frontier.

The above scale of sanitary equipment can be summarized as follows:—

Kerosene tins	..	..	..	..	..	..	..	60
Fly-proof covers for kerosene tins	..	..	..	..	..	..	..	27
British latrine pans	..	..	..	..	..	..	..	35
Officers' folding commodes	..	..	..	..	..	..	..	3
Indian latrine pans	..	..	..	..	..	..	..	10
Latrine screens and poles	..	..	..	..	..	..	g.s.	
Iron incinerator bars	..	..	..	..	..	..	..	24
Strands broad "bhoosa" wire	..	..	..	..	..	..	..	30

Urine funnels	6
Riddle for litter	1
Rakes for litter	2
Corrugated iron sheets for ablution bench and field ovens	26
Sand bags	100
Flags, miscellaneous	4
Sign boards for latrines, etc.	q.s.
Toilet paper	q.s.
Overhead screening for cookhouses	q.s.
Cement maunds	2
Lime maunds	10
Creosol, crude oil, kerosene oil and bamboo oil	q.s.
Horrocks's Box	1
Bleaching powder	q.s.
Shower bath	1

As there is now attached to a British Infantry Battalion, an Indian Machine Gun Platoon, comprising 2 Indian Officers and 43 Indian other ranks, it is advisable to take 12 additional kerosene tins for sanitary purposes in connexion with these additional troops.

The above sanitary equipment can be carried on 5 Army Transport carts.

This scale is not an absolute minimum to carry out satisfactory sanitation, but it has been found to be a fairly accurate scale for general use. Tins brought to camp are often found unserviceable on arrival, others get lost or stolen. If the Medical Officer can arrange to take all this sanitary equipment to camp, then he knows that he can get a satisfactory and sanitary camp going at an early date. If he has too much improvising to do, then his camp is probably not a satisfactory sanitary proposition until the time comes to strike camp, and perhaps not even then.

It is a sound principle to take the list of sanitary equipment to the Regimental Quartermaster a clear month before proceeding to camp. If the Quartermaster is made to see the reason for taking so much equipment to a temporary camp, the Regimental Medical Officer can proceed to interview the Officer Commanding the Regiment on the matter. As the Officer Commanding the Battalion will probably send for the Quartermaster as soon as the Regimental Medical Officer commences talking about sanitary equipment, or camp sanitation, the reason for talking matters over with the Quartermaster first is obvious.

If the Officer Commanding the Regiment says that only half, or less of the sanitary equipment suggested can be taken, then a careful explanation of the necessity for taking so many things, and a gentle reference to the responsibility for sanitation resting with the Officer Commanding, will often make him see light in the matter.

IMPROMPTU CÆSARIAN SECTION AT KASAULI.

BY CAPTAIN BRUCE, O.B.E.

Royal Army Medical Corps.

THE following case is reported as one of interest: Nahoo, a native woman, aged 30, who had had six previous normal confinements, commenced labour at 2 p.m. on April 23, 1922. At one and a half hours April 24, 1922, a hand presented and was drawn down by the native midwives in attendance. They applied almost continuous traction on the hand until ten hours, four of them taking it in turn to attempt delivery by this means. At ten hours they got frightened and sent for medical assistance. I saw the case and found the woman in a very small and dirty house in the Bazaar. A right hand deeply cyanosed was presenting and extending from the vulva up to the elbow. The head was lying in the right transverse position, occiput posterior, the presentation being now a typical impacted transverse. The uterus was contracting very strongly. The patient was removed to the cantonment hospital where I attempted to replace the hand and perform version under chloroform anæsthesia. The attempt failed, and fearing rupture of the uterus, I sent for Lieut.-Col. Ryan, C.M.G., D.S.O., V.H.S., R.A.M.C., he also attempted replacement and version but failed. The uterus was now showing marked signs of rupturing with well marked retraction ring, we decided on immediate Cæsarian section. At eleven hours the operation was successfully performed by Lieut.-Col. Ryan, and a living male child delivered. The placenta was on the anterior wall. The uterus was then well douched out and closed. The child's arm was deeply cyanosed to the shoulder joint, but not paralysed or dislocated.

A catheter had to be passed that evening, and for three days after. Next morning a vaginal douche and enema were given.

The wound was dressed on the third day. On the evening of which severe bronchitis developed, but cleared up in eight days under treatment.

The stitches were removed on the eighth day when firm union was found to have taken place. Convalescence was uneventful.

The chief points of interest are :—

(1) The absence of sepsis after free handling for twelve hours by native midwives under very septic conditions.

(2) The birth of a living male child after ten and a half hours' impaction.

(3) The absence of brachial paralysis or dislocation of the child's arm after prolonged and vigorous traction.

(4) The rapid convalescence in spite of complications in a case already exhausted prior to operation.

This is the fourth successful case of Cæsarian section performed here during the last two years.

DIAGNOSIS OF TYPE OF INFECTING PNEUMOCOCCUS IN
CEREBROSPINAL INFECTIONS BY PRECIPITIN TESTS APPLIED
TO THE SPINAL FLUID.

BY BREVET LIEUTENANT-COLONEL H. MARRIAN PERRY

AND

MAJOR J. A. MANIFOLD.

Royal Army Medical College.

In a monograph of the Rockefeller Institute for Medical Research on acute lobar pneumonia (No. 7, October 16, 1917), a clear and comprehensive exposition is given, both of the methods available for determination of type of the infecting coccus and the lines on which specific treatment by therapeutic type serums should be based. The determination of type of the infecting organism can be effected either by isolation of the pneumococcus by means of animal inoculation and subsequent agglutination tests with specific type serums, or by means of the precipitin test, the patient's urine being employed as the antigen, and the test made with clear and non-hæmolyzed specific serums of the three types. The former method has yielded the most satisfactory and consistent results, the latter has in our hands failed except in severe and profoundly toxic cases of pneumonia. Whichever method is employed it is obvious that rapidity in determination of type of the invading organism is essential in order that specific serum treatment can be commenced at the earliest opportunity.

With reference to diagnosis of the type species of organism responsible for the infection in cerebrospinal meningitis of pneumococcal origin, the monograph referred to recommends the method of isolation of the organism in these cases, either by direct culture or by animal inoculation, and subsequent agglutination determinations. As the necessity for rapidity in diagnosis and specific treatment is even more evident in this condition than in lobar pneumonia, it follows that the delay necessarily attendant on this procedure must react unfavourably on the possibility of successful serum treatment. It is more especially in this connexion that the precipitin test may be expected to yield results almost as consistent as those following agglutination tests applied to the coccus itself.

The readiness with which the pneumococcus undergoes autolysis in the fluid in which it is growing and the fact that in the great majority of cases of pneumococcal cerebrospinal meningitis it is present in pure culture, are factors which increase the probability that the spinal fluid withdrawn by lumbar puncture will act as a satisfactory antigen. In addition, the fact, determined by Dochez, that the pneumococcus in the early stages of its growth forms a readily soluble substance which diffuses into the culture medium *in vitro*, and in human and animal infections is present in the blood, and that this soluble specific substance is not attributable to the death and subsequent disintegration of the organism, suggests that precipitin tests with the spinal fluid are likely to yield successful results.

The above remarks have been prompted by the recent investigation of a patient suffering from cerebrospinal meningitis due to the pneumococcus. The type of infecting organism was very clearly defined by a precipitin test applied to the spinal fluid and was subsequently confirmed by agglutination of the isolated organism.

METHOD OF MAKING THE TEST.

The cerebrospinal fluid is centrifugalized, and the supernatant fluid pipetted off the mass of deposited cells and organisms. This clear fluid is distributed in three tubes of narrow calibre, 0.5 c.c. being placed in each tube. The same quantity—0.5 c.c.—of type serum for type 1, 2 and 3 pneumococcus is added to each of the three tubes. The reaction becomes evident either immediately or after an interval, as a fine haze at the junction of the liquids, and subsequently as a clearly defined precipitate in the tube containing the mixture of cerebrospinal fluid and the type pneumococcal serum corresponding to the infecting organism.

It is essential that the pneumococcal serums employed should be free from hæmolyssed red cells and crystal clear.

Travel.

AROUND THE WORLD.

BY LIEUTENANT-COLONEL C. R. L. RONAYNE.
Royal Army Medical Corps (Retired).

(Continued from p. 149.)

FEBRUARY 18: Shopping and a stroll round town. The Botanic and Domain Gardens are joined together and on one side are fringed by the sea, and on the other skirt the town. Judged by appearance they are kept up regardless of expense. Fine open drives, shady paths, green swards, a labyrinth of shrubs and gay flowers. They are perfect fairy gardens in design and beauty.

Man is of course of the gregarious habit; but this clubable disposition, is, I think, brought to a fine art by the profession, and other professions in Macquarie Street; which is the "Harley Street" of Sydney (I noticed the same thing in Melbourne). The doors, walls, and railings of doctors' houses are literally plastered with the brass plates of doctors, dentists, specialists, and female massagers—I beg pardon, I mean masseuses. Here is what, through curiosity, I copied from the front of one house, and it is typical of many: "Dr. — F.R.C.S.E., Cantab.;" "Mr. — Dental Surg.;" "Dr. — Dis. of Blood;" "Dr. — Dis. of Skin;" "Mr. — Dental Surg.;" "Miss — Psyc. Therap. Masseuse." As many of the houses appear to be of only moderate dimensions, there must be a bit of a crush inside.

In conversation the Secretary of the Royal Prince Alfred Yacht Club (of which I have been made an honorary member) told me that before the war they provided races for dinghys of six and eight feet over-all. I once had a dinghy of ten feet with a dagger-plate centre-board, and I thought

this was about the limit. But six feet! These have four feet six inch beam and carried a crew of two. All the sailing boats here are of the skimming-dish type, with great beam, and carry very large crews in proportion to their size. For instance, the ten footers have about five feet nine inch beam, and carry a crew of four or five. The twenty-two footers carry a crew of twenty-two. These sailing boats are typical of Australia; and though there are crowds of them at the different harbours, especially Sydney, there is no difficulty in finding the large crews necessary. The reason is, that sailing in them provides excitement for all. When the boat leans over to a puff, the crew swing their bodies out over the weather gunwale, with their feet caught under a batten running along the floor, and a short rope in their hands; as soon as the puff eases, by pulling on the rope they get quickly inboard to prevent her capsizing to windward. I have watched them sailing in strong puffs, alternating with calms from the hills, and it is remarkable how "nippy" the crew are, and the smart way they work together at getting in or out. It is only by this smartness capsizes are prevented, as the boats are very heavily canvassed in proportion to their size, and being only skimming dishes as regards draught, and with such big crews, capsizing to windward is just as likely as to leeward. So there is continual excitement and interest for all. The crew are very scantily dressed, many being only in bathing costumes and the spray which is frequently shipped is pleasantly cooling in the semi-tropical sun—but from this, it will be seen that boats of this sort would never "take on" at home, as the days at home when one would enjoy a good spraying when sailing are few and far between.

February 23: On 21st I got a "day off" and went by train to the Wentworth Falls, about sixty miles inland and situated in the Blue Mountains. I believe there are many picturesque spots in these mountains, but certainly a trip to these Falls should not be missed. The mountain torrent falling a clear 500 feet, together with the surrounding scenery is one of surpassing beauty and grandeur. By the National Pass one descends by a path cut in a rock (towering for a thousand feet) until under the waterfall. An awe inspiring spot.

Yesterday morning we moved out and in the afternoon arrived at Newcastle about sixty miles north of Sydney. Passenger ships coal at Sydney, but cargo ships at Newcastle, so it may be considered as "out of the beaten track." Owing to the coal trade, it is, in its way, a rather flourishing town with a population of about 60,000. It is the first place I have seen steam trams running in the streets. I suppose the city fathers argue that as the air is already stiff with coal-dust and soot, a pint or two more of soot won't matter much.

To-day went to the local sports and show. The trotting races, and jumping were very interesting. It was interesting to see the way the horse about to jump was brought up to the jump, and patted on the neck by his rider, whilst he smelt and "nosed" the bar for a minute or so, then

he turned round and walked away apparently without guidance; when about sixty yards from the jump the rider, by a very gentle tug at the rein, would slightly tilt the head, whereupon the horse seemed immediately to "become possessed," and nearly unseating his rider with the suddenness of the swerve, would dash like greased lightning at the jump. All the five competitors cleared 6 feet 9 inches, and two horses did 7 feet 3 inches, thereby beating the previous local record by 1 inch. The trotting races were more picturesque than ordinary horse racing, but the appearance of some of the horses was marred by the "spancels" or trappings round their legs to prevent them breaking into a canter or gallop. Though they look cumbersome and obstructing, apparently these trappings do not interfere with the pace.

In the evening went to the Ocean Baths and amongst other events, saw the famous swimmer, Beaurepaire, try to beat the world's record for 200 yards, but he failed. Altogether an enjoyable day.

February 26: On the morning of 24th we had a heavy thunderstorm; and that evening had trouble with the Australian coal trimmers. They refused to work as the ship's native crew were near-by doing some other work. The natives had to be stopped. These trimmers get 3s. 6d. an hour; and 4s. 6d. after four o'clock. It is "unskilled labour." Coal in Newcastle is 30s. a ton to householders.

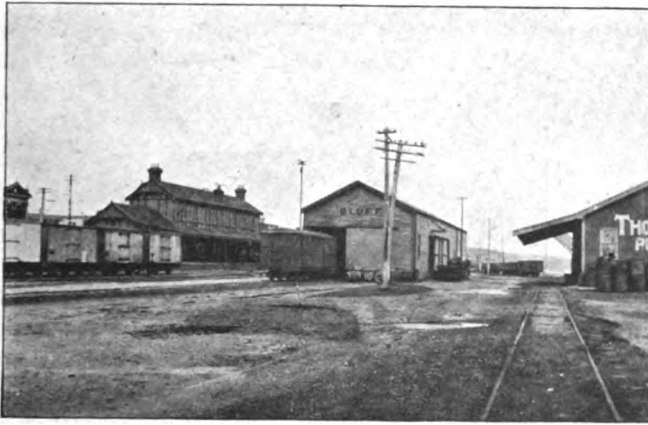
Yesterday we left Australia and are now on our way to New Zealand, with a calm sea and light north easterly wind, and accompanied by several albatrosses. It is fascinating to watch these fine birds as they ceaselessly swoop and glide about the ship, apparently never tiring, and never resting. They glide and soar about, even in the teeth of a gale, and keep up with the ship without apparent effort—at least if watched ever so closely no flapping of the wings can be detected.

Though birds know by instinct how to use their wings so as to make full use of the principle of the "parallelogram of forces," and the "inclined plane," still it is not possible they can keep going indefinitely by merely gliding; an occasional fillip to the wings must be given, to keep, so to speak the ball rolling. As no movement can be detected even by the most careful observation, it was for long a puzzle how they got this fillip or impetus.

But modern photography has solved the puzzle, and it can now be shown by photos taken at about one fifteen-hundreth of a second, that birds when apparently only gliding occasionally flap their wings—but the movement is much too rapid to be detected by the human eye. I believe aeronauts have recently been directing their efforts along the lines of these gliding movements, and in my humble opinion, sooner or later it will be found that the present powerful engines of flying machines are much in excess of requirements.

February 28: This morning when we got up though the sea was calm the wind was rising, ugly dark scud was coursing across the sky, and

the barometer showed a marked fall during the night. In the course of the day nothing worse happened than a bit of a breeze during lunch, due to somebody remarking that he had just read in a book that the Scotch, with the exception of the Esquimaux, are the dirtiest people in the world. As one of the officers present happened to be a Scotchman, he took the matter up warmly. I forget now the exact drift of his remarks, but as well as I remember he contended that some of the African Cannibal Tribes were dirtier than the Esquimaux.



RAILWAY STATION, BLUFF, NEW ZEALAND, THE MOST SOUTHERN RAILWAY STATION IN THE WORLD.

March 2: Yesterday we arrived at Bluff. As we drew near the harbour we saw four steamers approaching us in line, and equi-distant from one another. The battle-line formation seemed to be so perfectly kept, that we thought it might be the Russian or Chinese high-sea fleet, but the pilot reassured us, and said the day was the opening day of the oyster season, and they were only trawling for oysters. Bluff is a neat village of about 1,600 inhabitants situated on the most southerly point of New Zealand. Its importance lies in that it has two stores for cold-storage of meat; and to acquire some of the meat as cargo is the object of our call. One of the picture post-cards sold in the shops here shows a local hotel, and at the foot is written "the most southerly hotel in the world." Another post-card shows the railway station with a similar announcement. I believe the question of the hotel is disputed, as it is claimed there is one on the Falkland Islands off Cape Horn. On this point I cannot say; but there is no question about the local railway station being the most southerly in the world. So here we are at the end of the earth!—but are we? As the ship, yesterday, drew alongside the quay—or to be more accurate, the wooden jetty, a lady and gentleman were walking along it. He was well dressed, and had a military look

about him. But what, I think, chiefly caught the attention was the lady's heels. They were certainly the highest and most curvy I've ever seen; above them were slight ankles with a coating of shimmery silk around them, and she wore a coat of rich royal ermine. They would have passed more or less unnoticed in Bond Street or Piccadilly; but here they were! at the end of the earth! on the rickety old jetty! with no alternative when they got to the end of it, but to step into the sea, or stumble into a musty old tug boat; because except for ourselves, the oyster catchers, and the tug there was not a thing afloat. A man who had lived in Bluff



CAN ANY OLD T.C.D. MAN RECOGNIZE WHO THIS IS? HE ENTERED IN 1896 (OR 7).
HIS INITIALS ARE J. A. H. (See Notes of March 2, 1922.)

for twenty-seven years could give us no information about them, except that they were strangers. He said the tug-boat made a trip once a week to Stewart Island and took passengers to it if there were any. Anyway with her heels and ermine she jumped on board the old tug, and they soon steamed off. Who were they?

Stewart Island is about thirty miles due south, and is uninhabited except for a few Maori fishermen. It is preserved by the Government as a breeding place for birds and native fauna.

When going ashore to-day a well-dressed man came up to me and asked me if I was the doctor on the ship; on replying in the affirmative,

he said, "I was coming down to see you as I heard your name mentioned, and it occurred to me you might be the Ronayne who was in Dublin University with me." We then had a great greeting. After three or four happy years in the Medical School T.C.D. he chucked medicine. He is now a prosperous and influential "Sahib" in the district around here.

He introduced me at the local tennis club, where I had some good sets this afternoon.

March 3: Went to Invercargill in the morning, and bought for only 10s. an excellent little oil painting of Bluff Head. A similar painting in London would be cheap at two guineas. Invercargill is a goodish sized town of about 12,000 population, and twenty miles from Bluff. English, Scotch and Irish names are of course very common in Australasia, and though the name Invercargill sounds very Scotch, I think I am right in saying it does not occur in Scotland. How it came about was this: One, Dr. Cargill, was one of the original settlers here, and an influential man in the district; as houses increased, the question of giving the hamlet (as it then was) a name arose. Some wanted to call it "Inverness," others "Cargill," so they split the difference and called it "Invercargill."

Returned to Bluff by an early train and had a good four at tennis in the afternoon. After tennis we adjourned to the Eagle Hotel for dinner. I had ordered the dinner beforehand for four, but I did not give particulars, except that I wanted a good one. The dining-room was comparatively large and a model of neatness and good taste; the "laying" of the table was all that could be desired. The dinner consisted of six courses, commencing with oysters, and each course so liberally supplied that it constituted almost a meal in itself. We drank all told, 3 whiskies and soda, 1 stout, 1 lemonade, 4 glasses of port. The bill, including the drink, was only 21s. I felt almost ashamed to pay it, it seemed so modest—especially as the dinner had been specially prepared, and attendance and everything was specially done, because in New Zealand the dinner hour is 6 to 6.30, whereas we did not dine until nearly 8. But in Australasia everything in the food line is reasonable to cheap.

Here delicious pears cost only 1d. each, which at home would cost 6d. to 8d. Peaches, plums, apples, grapes, and pine-apples are also abundant and very cheap. The tea-scones, and even the ordinary bread, have a rich nutty flavour all their own, and the butter is excellent. A good meal can be got for 1s. 6d. to 2s. At the railway restaurant, Sydney, I had a four-course dinner of more than I could eat for 2s. 6d.

This is in the food line—on the other hand, everything connected with wearing apparel, and household effects is poisonously dear.

When I heard the ship was going to Australia I rejoiced, as I knew we were going to the home of skins and so I would be able to lay in a stock of excellent but cheap boots, to last for years—but what a sell! The country-made boots I would not present to an enemy; whilst all the "classy" ones are high priced British made, and the knobby-toed sort

from America—the sort that kick you in the eye when you only look at them. When having a hair-cut in Melbourne I overheard the barbers assistant telling a friend he had just paid £10 for a suit. In Australia, when ashore, I used to wear the ordinary slate-coloured flannel trousers, along with a light-coloured washing coat of “crash”—the only one survived from former onslaughts of the Indian “dhobi”! I thought I would stand myself a similar coat, or one of “tussa” silk, so that I could have one at the wash. So I looked around and in a shop window saw a suit of “tussa” silk. It was one of the ordinary “reach-me-down” sort, one for which the “dersey” would ask 25 rupees, and take 15—and much less before the war. The price marked on it was £7; so I did not pursue the matter further, and I am still without a second washing coat—but *en passant* I would remark, I managed very well without it; I used to have the “crash” coat washed in the morning and dried in the engine-room, and by lunch time it would be well ironed. But it is not now in use, as it is much cooler here than in Australia.

Furniture, tools, and all sorts of equipment are also very stiffly priced.

March 5: No tennis possible yesterday owing to fearful wind and rain. But last evening we had a pleasant time at the house of one, Mr. P——. Whilst two of the men present were singing a duet, a terrific storm of hail and thunder broke. They rose manfully to the occasion, and for a moment I thought they would succeed in drowning the storm, but fortunately, I mean unfortunately, the storm prevailed and their voices were completely drowned midst the rattle of the hail and clash of the thunder; however, they struggled on manfully, and just as they got to the last top note of the song, the thunder gave its final clap; it was so well timed and fitted in so nicely, that several of us forgot to clap also. It was a merciful release—from the storm.

To-day is almost as stormy as yesterday. This morning a fine shark passed along quite close to the ship. I have hitherto been somewhat sceptical about the “pilot” fish supposed to accompany sharks—but right enough, there were two fish, about the size of herrings, swimming one on each side of his head. He was swimming slowly along, quite close to the surface, so the three could be plainly seen. He looked to be about 14 feet long. By the way, the Australian papers recently received here are full of another shark tragedy; almost exactly similar to the recent one, and at the same place (Coogee). It is believed to be the same shark, and a hundred pounds reward has been offered for his capture. As a result, great crowds of people, breathless with suspense, watched natives from the South Sea Islands, armed with knives, enter the water and swim about in the hope of being attacked by the shark—but nothing happened. These Islanders are of course at home in the water—still what daring fellows they must be!

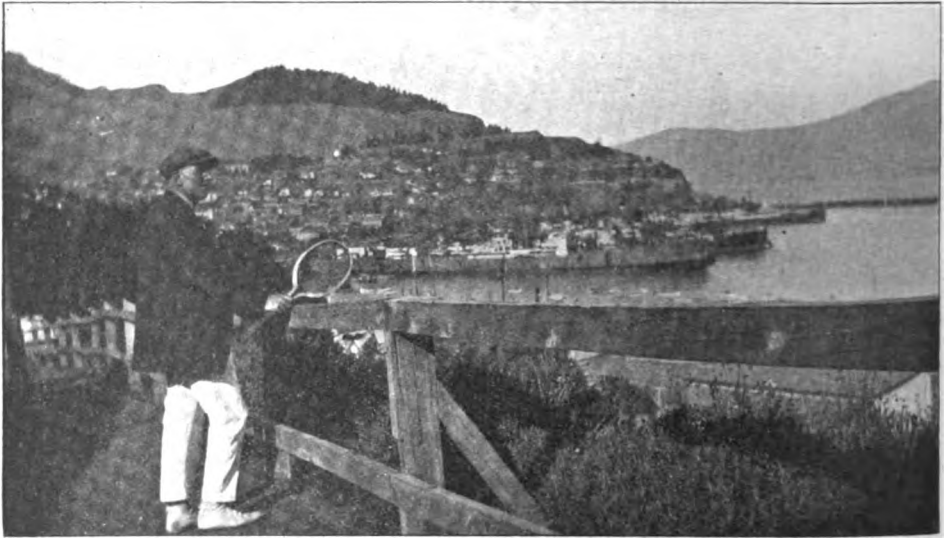
There are a good number of Tee-Tee (“Mutton”) birds in the harbour. These birds are so highly prized by the Maoris as almost to constitute a

staple food with them ; and the Government preserves the birds for them. The season commences on 2nd of April, when numbers of Maori collect at Bluff and proceed to the many small islands close by. The bird lays a single egg in a burrow, about the length of one's arm, in the ground ; and when the season commences, the young one is caught in the burrow, just before it is able to fly. The soil of these islands is of a peaty nature and so suitable for burrowing in. When caught, the bird is split open and after being cleaned is salted ; they are then put up together in air-tight bags made from the great leathery sea-weed so common on the coast here. In a shop a woman showed me some of the birds ; they were about the size of average chickens ; all had been salted and some had been roasted in addition. The price of the roast ones was 1/2 each, and the others 10d. In appearance they looked quite fresh, but she said they were those of last year. The strong fishy odour from them was enough to nearly knock me down, but I have heard several people speak highly of the flavour. Though they are killed by the hundred thousand, there is no risk of their extermination, as they exist, I am told, in myriads on the islands.

But whenever the season may be for the Tee-Tee bird, there can be little doubt but that this is the oyster season—at least judging by the condition of some of the officers' cabins. They seem to have laid in a fine stock of the delicacy, and to spend a good part of their spare time guzzling the delicious morsels. Why is it that even the mildest of men assume "airs," and sometimes even show intolerance when discussing oysters ? One will say, to eat them without caviare is an outrage. Another that they should be sprinkled with powdered fennel, soaked in rum, and finally washed in a cocktail of green chartreuse. And so on. When I go into an officer's cabin, he does not say, "have an oyster old man" ; all ordinary hospitality seems to be dead ; but he immediately starts off with a lecture on how to open and eat them. He explains that the contained water is the key to the situation ; and that the man who lets it drain off prematurely is a barbarian and should be shunned. And in confidence assures me the man in the next cabin knows nothing about them. Then when I go to the next cabin I hear the same thing ; he shows the exact spot on which the shell should be struck and how many times to strike it, etc., etc. He in turn has no use for the methods of the man whose cabin I have just left—in fact, they are so primitive he should not be allowed to have oysters.

But what beats me is, why all these Lamellibranch gourmands should join hands and look down on the patrons of the Gasteropoda. Yet they do so. For instance, walk along the esplanade at Margate with a man who has just filled himself with oysters, and I'll guarantee he'll not pass the barrows, around which crowds are stuffing themselves with winkles and cockles, without making some sarcastic and persiflagistic comment. Personally I cannot see what the difference is, from an eating point of view, between an oyster and a winkle, except that the intestine and liver, especially the liver, is larger in the oyster. But then I am neither a winkle nor oyster expert !

March 8: We left Bluff at 7 a.m. yesterday, and we left the wind and the rain behind us, and after a pleasant passage arrived at Lyttelton at 7 a.m. this morning. Great steep mountainous hills descend right into the sea and form a fiord about three miles long, at the top of which is Lyttelton. The harbour is very snug, and has accommodation for about twelve ships of our size, and it is being enlarged somewhat ; but there is no future for the town as regards expansion, as the hills are much too steep and inhospitable for building on.



THE HARBOUR, LYTTELTON, NEW ZEALAND.

A railway tunnel a mile long pierces the hills, and goes to Christchurch which is distant ten miles, and situated on the Canterbury Plain.

Went to Christchurch. It is a fine town with many good shops, but streets irregular, and on the whole looks a bit old-fashioned, with nothing much to catch the eye, except the river Avon which flows through the town ; and is very picturesque, due to the many luxuriant weeping-willows which line the sloping grassy banks, whilst the purling river wends its way along, and reflects the sombre shadows of the willows.

The museum is excellent. It is well kept, and has an interesting collection. As one enters there is a tablet in the wall eulogizing Sir Julius von Haast, F.R.S. He appears to have endowed and founded the museum. There is also at the entrance an interesting framed roll of "Pilgrims who could answer the Roll Call, December 16, 1907. Arrived in Port Lyttelton December, 1850." There are then the people's names in their own hand-writing, also their photos.

A foot note made in red-ink states : "On August 2, 1919, 54 out of 840 were living."

There is, of course, no comparison between the Museums of Australasia and the London Museums, or say the Louvre in Paris. But museums out here have an attraction of their own, especially for the traveller, as they



RIVER AVON, CHRISTCHURCH, NEW ZEALAND.

have not only a picked selection of interesting things, without a surfeit, but they have all their departments including the picture gallery in one building—Sydney is the exception, as its picture gallery is apart.

March 9: Had one C—— to lunch. After lunch we were enjoying a cigar and coffee, before going up to tennis, when all of a sudden there was a bang, and a whirr, and without the least warning a hurricane was

on us. It was so sudden, C. thought it would end equally suddenly. The glass was then 29·4. In fifteen minutes it had gone up one tenth; and in another fifteen minutes it rose another tenth. Just then the rain came down. This was the quickest rise in the glass I have ever seen, and the curious thing was, it started to rise the minute the storm broke, and had risen two tenths before the rain started, and moreover, the storm did not suddenly end, but gradually blew itself out in five or six hours. A good deal of damage was done on shore.

To-day we heard of an interesting case which recently occurred in the district. The child of wealthy parents was badly afflicted with bandy, or bow-legs. The best surgeons and physicians having failed to effect a cure, it was decided to give the Christian Scientists a trial. They undertook to try; and so, three of the leading exponents, together with the child, were closeted in a room. For three hours the Christian Scientists exercised the most intense mental concentration, without a moment's relaxation. At the end of this time the blinds were pulled up, and the child examined—he was found to be suffering from knock-knee. Apparently the concentration had been over-done.

Across the harbour, just opposite us, is a fine five-masted schooner, and next her, a cargo steamer of over 4,000 tons, and built of wood; she is said to be the largest steamer in the world built of wood. But both ships are lying idle, and though they look to be in perfect condition, they are said to be badly affected by a species of worm.

March 12: Yesterday morning met Dr. T—. He is now Medical Officer on board a ship in harbour. I knew him when he was a temporary captain doing duty on the troopship "Prinz Ludwic," of which I was Senior Medical Officer. We immediately turned to and had several sets of singles at tennis. After lunch we left Lyttelton, and arrived in Wellington early this morning. The entrance to the harbour is narrow and dangerous owing to ugly isolated rocks dotted about, but once inside, it is a fine spacious bay completely surrounded by steep hills and mountains.

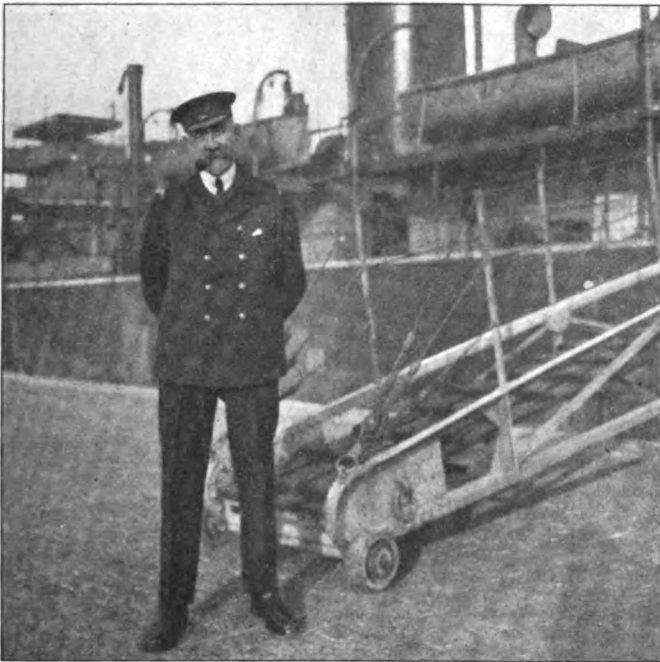
This afternoon I went to the seaside suburb Lyall Bay and had a swim, and saw "surfing" by standing on planks—this is the first time I have seen it "down under," though I believe it is done in Australia. I had heard a lot about surf-bathing in Australia, but I was disappointed with what I saw—judging by what I did see, it is not to be compared with that at Durban. After all this is, I think, as one would expect, because owing to the shark menace it can never be fully indulged in, unless enclosures are provided, such as the fine one at Durban.

March 14: Last evening dined at the Empire Hotel with one Dr. H. A fine hotel and good dinner. Dr. H. is the Medical Officer on the "Ruapehu" which has just arrived from England with about 300 emigrants. He recently retired from the Colonial Medical Service on a pension after twenty-five years' service, having been principal Medical Officer for some years before retiring.

In conversation he told me of one family on board which illustrates how some of the "new poor" strike out. That of a Lieutenant-Colonel, aged 58; wife about 10 years younger; 3 children, eldest a boy of 13.

He has only his pension and enough capital to buy a bungalow, and about ten acres of land. He estimates that his pension, together with cultivating the ten acres, and the cheapness of living out here will enable him to live in fair comfort and educate his children—which he could not possibly do now at home. Push and go at 58!

March 15: Went to the Wellington Club, of which I have been made an hon. member. A very good club indeed. (I am indebted to the Captain of the "Peshawur," G. Philipps, that I have been made an



THE CAPTAIN.

hon. member of this club, and also of the Royal Prince Alfred Yacht Club, Sydney, and the Royal Sydney Yacht Squadron.)

There is a Julius von Haast badly wanted in Wellington, for if ever a museum deserved the epithet, disreputable, here it is. Such a musty, frowsy old place, I have never seen, yet it rejoices in the exalted name of "Dominion Museum." It is a wooden bungalow about the size of an ordinary house; and I hear there is quite a valuable collection of things stowed away in some underground cellars, for want of space. Arise, Sir Julius! The museum contains a unique and interesting egg. It is one of

the well-known extinct Moa birds. The egg is broken, but the pieces are mounted so as to make it look whole, and on a tablet alongside it, are the complete bones of a fully grown chick which were found in the egg. It was "found at Cromwell in the province of Otago when excavating a road." How strange the egg of this extinct bird should have been almost hatched, yet it was not, but remained intact to be found in this way.

The Moa was exterminated by the Maoris about one hundred and fifty to two hundred years ago; a good number of skeletons have been preserved and mounted, but only very few eggs. One of the skeletons is twelve feet high; so the bird was a great deal bigger than the ostrich, which it much resembled. The largest egg is in the museum at Otago, and is about the size of a Rugby football; the egg here is about the size of a very large cocoanut.

Australasia is of course out of the "beaten track" for tourists and strangers, and so, in various little ways one notices this as one travels around—visitors from up country are catered for, but not strangers. One way in which this is noticed is, the lack of souvenirs or mementos to be had. Only in very few shops in Australia can anything be got; and where they can be, the selection is very limited. I bought a silver napkin-ring with the Australian crest and arms on it. But bad as Australia is for mementos, New Zealand is practically a wash-out—a few trifles can be had here in Wellington, they are, egg spoons with Maori figures on them; painted birds' eggs (to be broken on the way home); and odds and ends, made of a sort of greenish marble—it looks just like Connemara marble. But they all look so cheap and shoddy. However, I had to get something, so to-day I bought a Willesden green haversack for 6s. 6d.—not much, I admit in the "memento" line! still, always a useful thing.

Wellington is a fine city with some fine buildings. The new House of Parliament, which is in course of erection, is a splendid stone-cut building of stately design and proportions; but opposite it is a building so large that it completely fills a local picture post-card on which the inscription reads: "Government Buildings, Wellington; the largest wooden building in the world." The building is as large as any of the huge government ones in Whitehall. Though this is the largest, it is yet characteristic of many throughout Australasia, from large factories and emporiums, to the smallest dwelling houses. I believe a recent law prohibits any more wooden buildings being built in the *city* area. But this does not affect the suburbs, where one can walk for miles and not see a single house, either shop or living house, built of brick or stone—nothing but wood. On the very morning we arrived in port, eleven houses in a fashionable residential quarter were reduced to ashes—the whole lot in little more than an hour. The occupants made frantic efforts to save things but had no time, except to put them just outside the doors and throw them from the windows; but unfortunately they were not removed far enough and the fire caught them. It was pathetic next morning to see the gardens filled with burnt bits of

every conceivable article, from pianos and mattresses, to jewellery, dishes and tooth-brushes. A newly married couple who had returned from their honeymoon the day before the fire, lost everything—including the wedding presents. It is said wood is used for fear of earthquakes, to which the country is subject, but the people do not appear to be afraid to spend their days in the stone-built factories and shops of the city. Why not build of re-enforced concrete? which is practically earthquake proof. Wooden buildings did all right in the days gone by, when it was the thing to go to Australasia, and having "got rich quick," come home and live a life of ease—but those days are over. Australia or New Zealand now becomes the land of one's adoption, and a continuance of such buildings and bungalows can only tend, I think, to lessen ones *amour propre* for one's country.

(To be continued.)

Current Literature.

The Smallpox Epidemic in Basle, 1921, with special reference to the spread of infection by flies. By Dr. Hans Hunziker and Dr. H. Reese. *Schweiz. Med. Woch.*, May 18, 1922.—An outbreak of forty-three cases with eight deaths is described in considerable detail from an epidemiological point of view. The first case, in which infection was traced to Frankfurt-on-the-Main, occurred early in March. It was diagnosed as varicella and the patient mixed freely with other people, directly infecting four others. These five patients were isolated by March 30 and up to the end of May 13 more cases occurred and were isolated, in all of whom the exact source of infection was traced. The cases were isolated in two hospitals in the same part of the town.

Between June 1 and August 18, there occurred twenty-three further cases. The source of infection could be traced in only five of these cases in spite of the most searching inquiries. The eighteen cases of untraced origin all occurred in the immediate neighbourhood of the two hospitals, and there seems to be no doubt that this is another instance of the spread of infection from smallpox hospitals. The authors comment on the fact that the literature contains very few mentions of the possibility of transmission by flies. They regard this mode of transmission as highly probable in the present instance for the following reasons:—

The cases of untraced origin occurred during the hot weather when flies were very plentiful.

Six of these cases are stated to have occurred in very lethargic individuals who would not be likely to be careful to avoid flies.

Flies were noticed to be strongly attracted by smallpox cases in the pustular stage.

Three weeks after the provision of fly screens for the hospital windows the outbreak ceased.

The authors attempted to prove experimentally the possibility of transmission by flies but do not give details of their experiments which are stated to be incon-

clusive. They summarize observations by Sachs, Loeffler, Wawrinski, Veninger and Terni, as indicating that such transmission can occur. (See also "Flies and Disease," by Graham-Smith, p. 190.)

They further claim to show from this outbreak that the incubation period is shortened when the patient is partly protected by vaccination, that the disease is only very slightly if at all infectious in the incubation, prodromal, and papular stage, and that "the idea, still prevalent, that vaccination will not take on a person already infected and that as soon as a reaction occurs he can be released from further observation, is quite wrong." This refers to the fact, which they have observed, that a person vaccinated towards the end of the incubation period may develop both smallpox and vaccinia.

Note on the season at which "Hospital" outbreaks of Smallpox have occurred in England.—In the years 1877-1881, the incidence within a distance of half a mile of the Fulham hospital was markedly increased whenever the hospital was used for the reception of acute cases. In 1877 this occurred during the summer months (March to October), but in 1880 the period was from January to March. In 1881 the influence was manifested over the period January to September. (W. H. Power, Report of Medical Officer to Local Government Board, 1886.)

In the London epidemic of 1901 and 1902, when cases attributed to the influence of the hospital ships occurred in the Orsett Union, the greatest incidence was during the months September to March, a period which corresponded with the period when most cases were being treated on the ships. (J. C. Thresh, *Trans. Epidem. Soc.* XXI, 1901-2.)

In 1901-1903, the invasion of houses in the immediate neighbourhood of the three hospitals used for the reception of smallpox cases corresponded very closely to the use of each hospital, regardless of season. This occurred during January to October in the case of Fazakerley Hospital, during January to May for Park Hill Hospital, and during September to June for Priory Road Hospital. (R. J. Reece, Report to Local Government Board, 1903.)

In the Gateshead epidemic of 1903-1904 the period of greatest hospital influence was from December, 1903 to June, 1904, the time when the greatest number of cases were under treatment in the hospital. (G. S. Buchanan, Report to Local Government Board, 1904.)

It would appear therefore that the periods during which hospital-influence has been manifested in this country have not shown any definite relation to the fly seasons.

The Report of the Swiss Federal Council on Administration in 1921, discusses the outbreaks of smallpox in Switzerland during that year. In addition to the one described by Hunziker and Reese (abstracted above) there was at the same time an epidemic in Zurich Canton and another at the end of the year in Glarus Canton. These two, in contrast to the Basle outbreak, were extremely mild in character, no deaths occurring in 523 cases. The origin of these outbreaks was not traced, but they gave rise to another small epidemic in Argovie Canton of sixteen cases with one death.

Pellagra.—In the 109th Annual Report of the Royal Edinburgh Asylum, Morningside, it is stated that during last year there were four cases of pellagra, three of them fatal. At Rainhill Asylum during the years 1913 to 1918 there were thirty-six indigenous cases of which thirty were fatal. The returns of the Registrar-General for England and Wales for the years 1912 to 1921 show fifty-six deaths certified as due to pellagra. In April this year a death from the disease at Hanwell Asylum formed the subject of a coroner's inquest.

The ætiology of pellagra, which is still obscure, was exhaustively discussed at a meeting of the Royal Society of Tropical Medicine and Hygiene, on May 21, 1920. (*Transactions*, vol. xiv, No. 1). Allusion was made to the evidence brought forward by various workers that one or other of the following ætiological factors determines the incidence of the disease, and the opinion was expressed that it probably depends on two or more of them :—

- (1) Infection.
- (2) Bad sewage disposal.
- (3) Dietetic factors.
 - (a) Toxic.
 - (b) Deficiency of (i) protein ; (ii) one or other vitamines ; (iii) some unknown substance.
- (4) Sunlight.

It is suggested (*Hospital and Health Review*, N.S., vol. 1, No. 7, April, 1922), that in view of the prevalence of pellagra in tropical regions and the resemblance of the skin lesions to sunburn, it is possible that many cases of pellagra in temperate countries escape recognition owing to the absence of the characteristic eruption.¹

(A) Skin Eruptions in Influenza. (1) Leimdorfer, in the *Wiener klinische Wochenschrift*, August 26, 1921, says: An erythema may be observed, chiefly affecting the trunk and only to a slight extent the limbs, disappearing in two days without leaving any desquamation. In six cases a scarlatiniform eruption was present, usually at the height of the disease. In a small number there was an urticarial eruption on the forearm, hands, legs and feet.

(2) Osler mentions a diffuse erythema, sometimes purpura, also the frequency of catarrhal conjunctivitis.

(3) Dr. Goodall, of the North Western Hospital, Hampstead, writes to the *British Medical Journal* of September 25, 1920: "The rashes that occur after an attack of a specific fever do not consist solely of urticaria; a blotchy morbilliform erythema and *Erythema marginatum* are not uncommon, or a blotchy macular erythematous rash. These rashes are well known to those who see much of acute infectious diseases, and will be found mentioned as secondary or accidental rashes in most of the special textbooks.

"While many of the acute specific fevers exhibit special and characteristic rashes, these secondary rashes are common to all. I believe that they are a phenomenon of the process of immunization or perhaps of anaphylaxis."

Reviews.

ARTIFICIAL LIMBS AND AMPUTATION STUMPS. By E. Muirhead Little, F.R.C.S.Eng. London: H. K. Lewis and Co., Ltd., 1922. Pp. viii + 319. Price 18s.

This book is what it professes to be, "a practical handbook," and by those interested in Prostheses will be regarded as a valuable contribution to the subject. The author has with much skill avoided allowing the book to fall into the form of a mere catalogue. It is amply and effectively illustrated with plates and diagrams. A feature of the work is that Mr. Muirhead Little has laid stress on the mistakes which are to be avoided.

¹ Compiled for Ministry of Health by Lieutenant-Colonel S. P. James, C.I.E., I.M.S.

Unfortunately, the preparation of a book of this description must take a long time, and on that account it is of necessity not quite up to date. For example, recent modifications in Ministry of Pensions limbs are not dealt with.

As a historical survey of the work connected with artificial limbs prior and subsequent to the war it is extremely interesting, and the book should remain of value.

HANDBOOK FOR THE LIMBLESS. By G. Howson. London: The Disabled Society. Pp. xiii + 245. Price 1s. net.

The Handbook for the Limbless, published by the Disabled Society, should be of great value to those for whom it is intended. The information is concise, and is so arranged as to be easy of reference.

Presumably the book was written some time ago (the date of publication is not shown) and on that account the information on certain points is not up-to-date. For instance, time limits have been fixed within which applications must be made both for professional and industrial training under the Ministry of Labour. Under the Industrial Scheme reference might well have been made to the provision of concurrent treatment and training under the Ministry of Pensions in the large convalescent centres. In these centres men who require treatment, and who, as a result of their disability, are unable to follow their pre-war occupation, are given a thorough grounding in the technique of a new occupation. The object in view is to restore the disabled man to the world as a working unit.

A high note of optimism is reached in the section on "Recreations for those who have lost limbs," which has been compiled by many well known men.

In view of changes which are likely to take place in the organization of the arrangements for the care of the disabled, it might be well to consider the advisability of re-editing the book at a later date.

GUIDE TO A SECOND-CLASS CERTIFICATE (English). By F. P. R. Aldershot: Published by Messrs. Gale and Polden, 1922. Pp. 60. Price 1s. 6d.

A clear concise attempt to deal with the subject as required for the Second-class Certificate of Education.

The author has apparently a considerable knowledge of teaching methods, shows a good grip of the various component parts of the subject, and treats them in their true perspective.

The suggestions fall into line with the recognized new "Teaching Methods."

The hints on literature are particularly useful, giving all that is required for a Second-class Certificate, and also laying the foundation for further studies for those who propose to aim at a higher one.

The subjects set for composition might usefully be revised. The first five deal with subjects which are somewhat threadbare, and No. 13 requires a large amount of inside knowledge which presumably the candidate cannot be expected to possess.

Apart from the latter point, the book is one of considerable suggestive value to candidates for a Second-class Certificate of Education. E. S.

MANUAL OF PHYSIO-THERAPEUTICS. By Thomas Davy Luke, M.D., F.R.C.S. Edin. Formerly Physician, Peebles Hydropathic, Peebles. Demy 8vo, with many illustrations. London: W. Heinemann, 1922. Pp. xiii + 480. Price 25s. net.

The new edition of this work is greatly enlarged and the subject matter practically re-written. It is a most successful effort to include the recognized physio-therapeutical measures which have been found to be of the most value during and since the war.

The section on electrotherapeutics is not up to the high standard of the other five sections, as it is largely historical and further describes many simple pieces of apparatus in exhausting detail.

The best part of this section is the description of the Bergonie treatment.

MODERN METHODS IN THE DIAGNOSIS AND TREATMENT OF RENAL DISEASE.

By Hugh MacLean, M.D., D.Sc. London: Constable and Co., Ltd., 1921.
Pp. viii + 102. Price 8s. 6d. net.

The purpose of this monograph is to present a short practical account of some of the newer methods employed in investigating the renal function. The published work on this subject is somewhat scattered and not readily accessible for everyone so that the general practitioner should welcome this little book which will give him all the essentials.

It is essential that medical officers of the Services should make themselves acquainted with these methods as it is only by applying them that they will be in a position to dispose of their cases in a manner which is fair to the State and just to the individual.

Some of the most important points brought out in this work are the comparative insignificance of albuminuria, the estimation of renal function as a guide to prognosis and treatment and as a preliminary to operations for diseases of the genito-urinary tract associated with obstruction to the passage of urine, the diuretic effect of urea and its therapeutic use, the mistake of keeping patients suffering with chronic nephritis on too restricted a diet.

J. C. K.

THE PRACTICE OF MEDICINE IN THE TROPICS. Edited by W. Byam and R. G. Archibald. London: H. Frowde, Hodder and Stoughton, 1921.
Vol. i, pp. xxii + 856. 1922. Vol. ii, pp. xx + 1683. With many plates and other illustrations. Price £4 4s. each.

Vol. i contains sections on hygiene and minor tropical sanitation, nursing, medical entomology, laboratory methods (including a most practical subsection on the preparation of anti-variolous vaccine in the tropics), snakes and snake poisoning and toxicology.

Vol. ii deals with differential diagnosis, bacterial diseases, and protozoal diseases.

For an adequate review of a monumental work of this nature, each subject would require to be dealt with separately. It seems sufficient to say that this publication is a most valuable addition to the literature of tropical medicine and will be read and consulted by everyone interested in the subject.

The work entailed in getting together such a diversity of material must have been stupendous, and the editing of the work fills one with admiration. The publication of vol. iii will be awaited with interest.

FIRST AID X-RAY ATLAS OF THE ARTERIES. By H. G. Orrin, O.B.E., F.R.C.S. Edin. London: Baillière, Tindall and Cox, 1922. Pp. vi + 46.
Price 2s. 6d. net.

This small volume is a very condensed edition of the author's X-ray Atlas of the Systemic Arteries of the body, and will be a very useful help to those students of First Aid wishing to study the position of the arteries in situ, and especially the smaller and terminal branches.

Notices.

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ARE THE ACTIVE PRINCIPLES OF FILTER-PASSING AND
"ULTRAMICROSCOPIC" VIRUSES LIVING ORGANISMS
OR ENZYMES?

By H. M. WOODCOCK, D.Sc.LOND.

Fellow of University College.

IN his interesting paper on the filter-passer of influenza, Lieutenant-Colonel Gordon says (JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, xxxix, July, 1922, p. 1) that it is evident "that the infective principles in question are not mere enzymes, but living though extremely minute micro-organisms . . . from the fact that under favourable circumstances these filtrable viruses are capable of endless multiplication"; and he proceeds to describe certain granules which he considers represent the filter-passing organism of influenza. If it were shown that the "bodies"—or certain of them—found in these various diseases and regarded as the causal organisms were themselves actually capable of individual growth and multiplication by division, that would be proof of their vital nature. But this has not yet been done; and I think there is a valid explanation of the increase in amount of the active principles other than by multiplication *per se*.

In the first place, however, as I have recently had occasion (JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, xxxvii, 1921, p. 423) to discuss the question of the nature of various bodies and granules which are, in my opinion, essentially comparable, I may be allowed to give my reasons for considering that the granules described by Gordon are, in reality, protein-

¹ Until recently, Head of the University of London Department of Protozoology, which has been closed down for financial reasons.

granules resulting from the "breaking down" (by lysis or digestion) of organized material. Because, just at this period when medical opinion stands at the parting of the ways, as it were, in regard to the elucidation of the ætiology of these different "virus-diseases," and there is a marked tendency to incriminate as the causal organisms various minute, granular bodies whose chief characteristic seems to be that they stain best and most readily with Giemsa, it is extremely important that due emphasis should be laid on the care and caution necessary in interpreting results obtained by this method of staining, in order that, if possible, the wrong path may be avoided. In the paper already mentioned, I have referred to this matter (p. 322); and in the very same number of the Journal, Wenyon took the opportunity (p. 360) of pointing out that "though dried smears stained by Romanowsky stain are often very pretty as regards colouring, and are excellent for diagnostic purposes" (this in reference, more particularly, to protozoan parasites) "they are misleading from the point of view of actual structure of nuclei and cytoplasm." This is especially the case as regards the distinction of the essential nuclear constituent, namely, chromatin. As I endeavoured to show (l.c.), *everything that stains red with Giemsa is not chromatin.*

On the other hand—and this is equally important—unless an element retains a stain recognized by cytologists as a nuclear, i.e., a chromatinic stain, it must be gravely doubted whether such a body contains chromatin. *It is highly probable that all living organisms contain chromatin.* The late Professor E. A. Minchin, F.R.S., in his last published paper (an address on the evolution of the cell, British Association Meeting, 1915), set forth fully his reasons for thinking that chromatin was the primary constituent of living matter, and that the primeval forms of life were of the nature of particles of chromatin; and with this view I agree. If then the extremely minute granules which are now in question are living organisms, it appears most probable that their constitution is not far removed from this type. Now it could be argued, of course, that the chromatin in their case was in such a form or condition that it had no affinity for ordinary nuclear dyes such as hæmatoxylin; but in the light of our present knowledge I think this argument would be an extremely unsafe one upon which to rely. Because there is no difficulty in staining known, i.e., admitted micro-organisms, however small, with such a stain. Anyone who has had occasion to stain wet-fixed films of fæcal material with iron hæmatoxylin, for *Entamæbæ*, etc., will have noted how sharply and intensely stained the numerous bacteria, of all forms and sizes, stand out in such preparations. This is because the chromatin is present, usually, in the distributed form; in other words, it is not aggregated into a definite nuclear organella, but dispersed, more or less uniformly, throughout the body of the organism. A most important question therefore is, do all these various granular bodies, which stain red with Giemsa, contain chromatin or not?

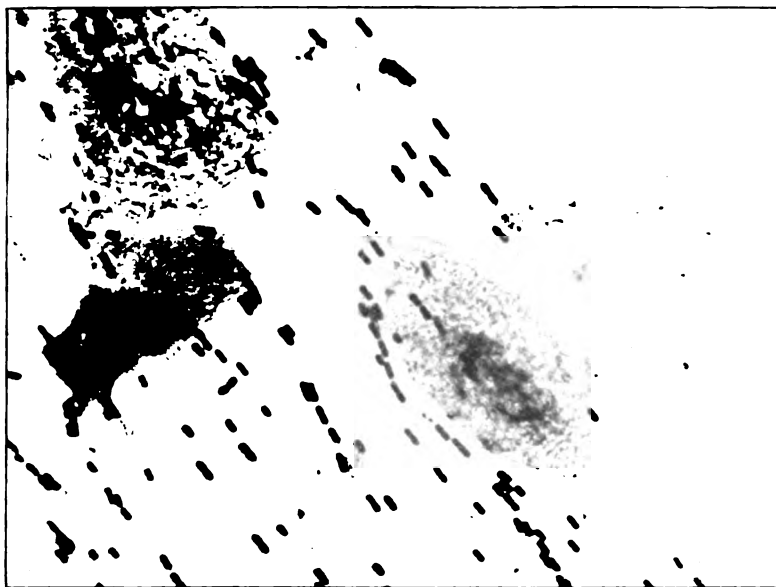


FIG. 1.

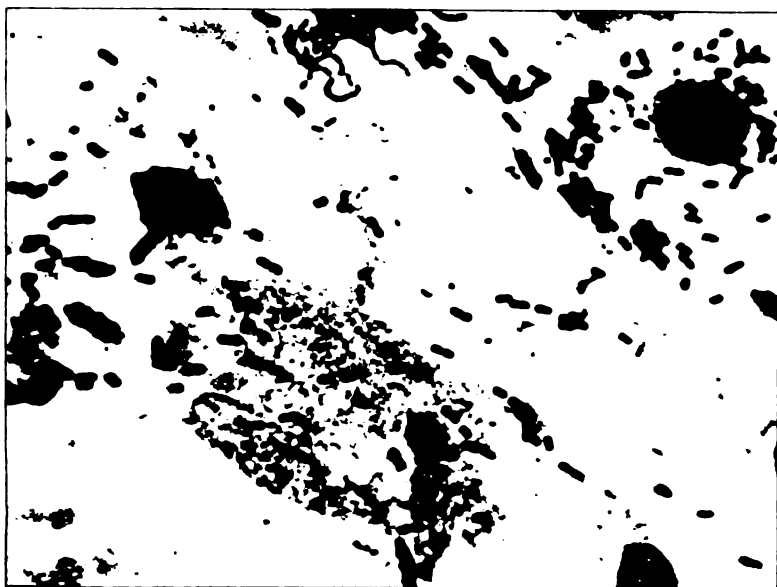


FIG. 2.

ON THE GRANULES RESULTING FROM KARYOLYSIS (KARYORRHEXIS).

I have not myself studied the filter-passing granules in influenza, but from the excellent figures given by Gordon, I think they can be regarded as entirely comparable with certain minute granular bodies which stand out prominently in Giemsa-stained smears of ordinary naso-pharyngeal secretion, which I propose to consider. For the photo-micrographs, I am indebted to Mr. A. Dennis, who most kindly and successfully came to my assistance in the absence from home of Dr. Reid. The magnification of the figures is, throughout, 1,000.

The smears were made of material coming from the back of the nasal passage, at a time when I had neither influenza nor "common cold"; they were dried, fixed in absolute alcohol and stained with Giemsa in the usual manner.

In such a smear, especially if it contains fragments of the thicker, more opaque portion of the secretion, there are, of course, plenty of cellular elements. These include epithelial cells, normal and "breaking-down," leucocytes and numerous bacteria, the latter being very useful for comparison. The most common kinds, in my smears, are two cocco-bacillary (or diplococcal) forms, one large and one small, and a streptococcus (fig. 2). All the micro-organisms stain either an intense purple or else almost a blue-black colour. Moreover, each type of microbe has, in the particular environment in which it is present, a characteristically constant morphological appearance, notwithstanding the numbers in which it may occur in different patches. As regards the normal epithelial cells, the nucleus appears fairly dense and sharply compact and shows nothing unusual (cf. the lower right-hand corner of fig. 2, where one is seen partly out of the field); it stains a dark red, or reddish purple. The cytoplasm of such normal cells is almost entirely free from granules.

On the other hand, "breaking down" epithelial cells show a progressive disintegration (karyorrhexis) of the nucleus; and the cytoplasm of such cells contains numerous or abundant little masses and granules of red-staining material. Figs. 1 to 3 show cells in different stages of this karyolytic process. The cell near the middle of fig. 1, as also that in fig. 3, still has a more or less definite aggregation of nuclear material in the middle, recognizable as its "nucleus"; but in that of fig. 2, the only recognizable remains of the nucleus is the aggregation of irregular masses of varying size near the right-hand end of the cell. Finally, in many cells, no trace of the nucleus, as such, is left; there is nothing but a great quantity of grains and granules thickly dispersed through the cytoplasm (fig. 5). (In this fig. there are five, and only five, diplococci lying completely over the cell.)

For my purpose, attention may be directed specially to two points. In the first place, all manner of transitional stages can be found between the larger masses, still manifestly representing nuclear material, and the smallest and finest granules; this is, indeed, apparent from the figures,

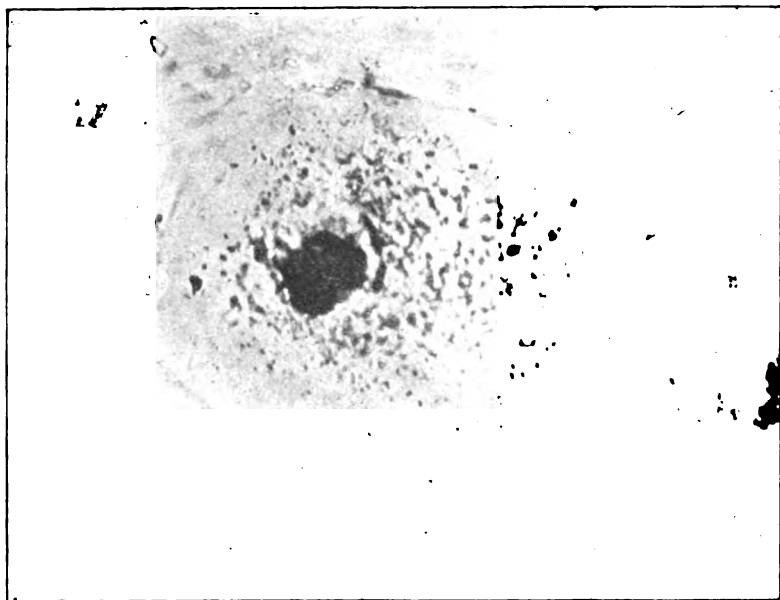


FIG. 3.

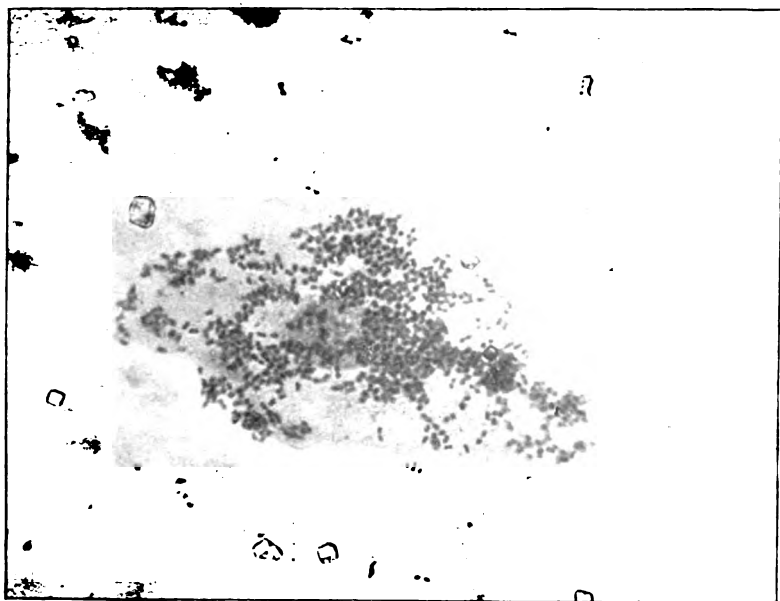


FIG. 4.

which could be multiplied at will. I will only add that the colour is of the same kind or quality as it were, throughout; only, of course, the larger the grain or little mass, the stronger and darker is the colour. And in this connexion the presence of the bacteria is most instructive. In figs. 1, 2 and 5, for instance, the large bacteria which happen to be lying over the cells can be distinguished unhesitatingly, not merely by their definite form, but by the different colour they stain (unfortunately, this is not shown, of course, in the figure); none of the bacteria stain in the least like these red-staining granules. I do not see how it can be doubted that these little elements, down to the most minute, result from the alteration and dispersal through the cell-cytoplasm, of the products of this karyolysis. Nowhere in the scale is it possible to stop and say: now we are dealing with something different, something of an organismal nature.

The other important point is the variation in form and size of these elements. Irregular masses, streaky forms, rod-like forms, granules—all can be met with, all merging insensibly one into another (cf. fig. 3, and also fig. 7).

With the final disintegration of the cell, these bodies become disseminated and, in the thinner parts of a smear, for instance, those corresponding to the thinner, more gelatinous portions of the secretion, many fields contain no cells, but only a vast number of grains and granules, down to the merest specks; the visible end-products of this cell-destruction embedded in the matrix (fig. 8). In the field shown, there is not a single micro-organism; but all these elements might be regarded, at first sight, as representing an "ultra-microscopic" virus, the smaller ones, certainly, being of filter-passing size.

The next question is, how do these minute bodies appear when stained by iron-hæmatoxylin? To answer this, I made films of the secretion, which were fixed wet in sublimate-alcohol-acetic and then stained in the usual manner; and, further, I divided the actual smear from which figs. 7 and 8 were taken into two halves, preserving the one half containing the particular fields illustrated, and de-staining the other similar half completely; I then re-stained this with iron-hæmatoxylin.

From a film, I have chosen the field seen in fig. 9, to show different stages in the karyolysis of dying epithelial cells. (This film was, purposely, slightly under-differentiated.) At (a) is seen a normal epithelial cell, with healthy-looking nucleus, the chromatin of which is chiefly arranged in little masses around the nuclear membrane. The chromatin is the only material in the cell which retains the black stain. The general cytoplasm is grey in colour and finely granular; here and there a few specks can be seen, but they mean nothing. If the differentiation had been carried a shade farther, so that the chromatin-blocks were perfectly sharp and precise, nothing else would have been prominent at all. At (b) is seen a cell whose nucleus is in an early stage of alteration; and what a difference is manifest. The sharp contour of the nucleus is lost, the nuclear membrane having been

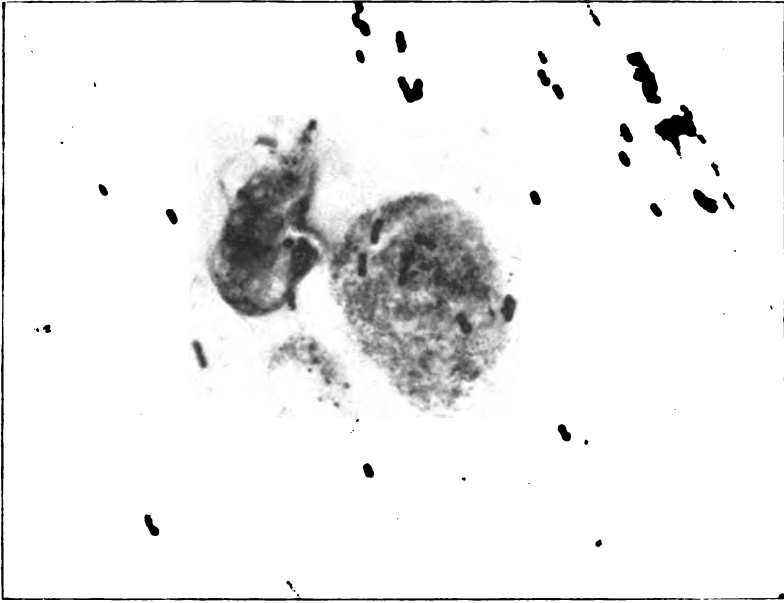


FIG. 5.

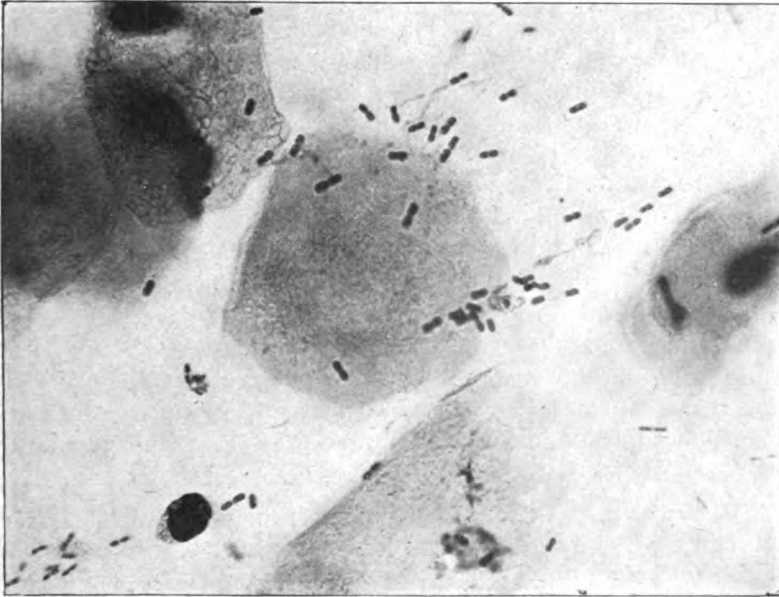


FIG. 6.

destroyed; the chromatin is in course of alteration and apparent dissolution; only two or three small masses still stain deeply, the rest of the nuclear material being vague and indefinite and rapidly losing its staining affinity. Finally, at (c) the nucleus, as such, has practically disappeared; only a few little granules near the central, rather clearer area, and a few others scattered about the cytoplasm remain to indicate, possibly, fragments of chromatin. (The darker bodies, rather out of focus, at the lower side of this epithelial cell, are the nuclei of polymorphs; it must be remembered that there is always more "depth" in a wet-fixed film than in a smear.) Now, the condition of the cell in (b) corresponds about to that of the cells shown in figs. 1 and 3; that of (c) approximately to that of fig. 5. But where are all the granules, the characteristic red-staining granules of those figures? They simply are not distinguishable, apart from the general granular cytoplasm; i.e., they have no affinity for this chromatinic stain. I consider if they were organisms, however minute, they would be visible, as minute but definite, black granules, after iron-hæmatoxylin just as they are after Giemsa, because they would contain chromatin. In the field shown in fig. 9, there do not happen to be any micro-organisms. In fig. 6, however, is seen an epithelial cell in which karyolysis is complete; no trace of chromatin is visible. And here there are plenty of organisms. What a contrast! The organisms stand out sharply and intensely stained:¹ but again, where, in the cytoplasm of the cell, are the granules and granular masses of the cell in fig. 5?

Lastly, I turn to the other half of the dried smear, corresponding to that from which figs. 7 and 8 are taken, which was re-stained with iron-hæmatoxylin. In a dried smear, it should be mentioned, the nucleus never stains properly with iron-hæmatoxylin; for some reason the whole nucleus stains in a diffuse manner, although intensely. But in fig. 4 is seen a cell in which the nucleus (near the middle) is only faintly stained—a grey colour, quite different from that of the normal nuclei in the same half-smear, which are black. I should say the degree of nuclear alteration here is about that of (b) in fig. 9, or of the Giemsa-stained cells in figs. 1 and 3. Note, however, how intensely stained is the smaller type of cocco-bacillus (or diplococcus) numbers of which lie on the cell. But the cytoplasm of the cell itself shows no granules! Moreover, all around is ground-substance, of the same character as that which shows abundant granular bodies in figs. 7 and 8. But merely a few micro-organisms are to be seen.

From these considerations, it is clear, therefore, that the minute bodies above considered do *not* contain chromatin, at any rate, as we know it to

¹ It may be added that by the kindness of Dr. St. John Brooks, Curator of the National Collection of Type-Cultures, and of Miss Rhodes, Assistant Curator, I obtained some cultures of *Micrococcus* (or *Bacillus*) *melitensis*, as being one of the smallest known micro-organisms in the Collection; from these I made wet-fixed films, which were stained with iron hæmatoxylin. The micrococci stand out prominently, stained an intense black.

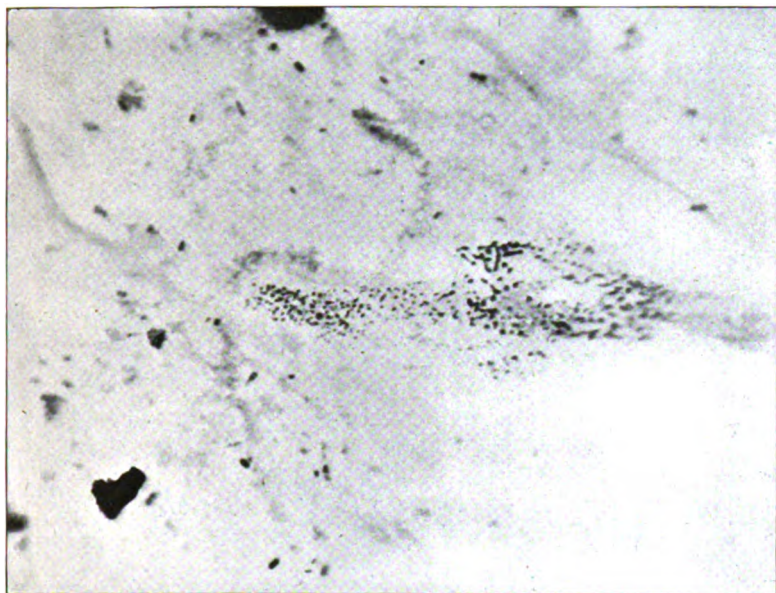


FIG. 7.

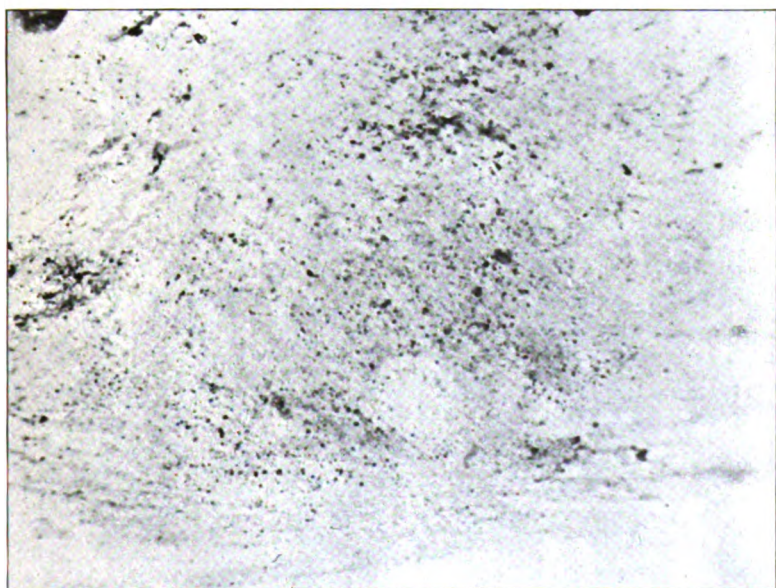


FIG. 8.

To illustrate "Are the Active Principles of Filter-passing and 'Ultramicroscopic' Viruses Living Organisms or Enzymes?" by H. M. Woodcock, D.Sc.Lond.

occur. On this ground alone, in my opinion, they cannot be regarded as living organisms; *quite apart from the fact that it is apparent, from the study of Giemsa-stained smears, that they are formed as a result of the breaking-down of the cell-nuclei.*

What then are these elements? I consider they are entirely comparable in nature and origin with various bodies, of all types and sizes, such as I have described in my first paper (l.c.); e.g., platelet-granules, "*Rickettsia*-" bodies, and the inclusions in Kurloff-bodies, Negri-bodies, Guarnieri-bodies and so on. All these stain red with Giemsa and remain unstained (colourless) after a precise nuclear stain. Let me recall, briefly, the nature of the inclusions in the Kurloff-bodies, as these, from their particular character, are most instructive as an illustration. I have shown that these represent a protein-moiety of the hæmoglobin of ingested and altered red corpuscles, the iron portion having been separated and constituting the more liquid, spherical globule in which the inclusions lie. Figs. 10 A and B, taken from Giemsa-stained smears of guinea-pig's blood, show two of the various forms presented by these inclusions; (in both cases the nucleus of the lymphocyte lies at one side of the Kurloff-body). In the former, there are numerous, red-stained granules, some of which appear like minute diplococci; in the latter, the inclusions appear as narrow bacillary rods, many of them simulating to a remarkable degree, micro-organisms. It is well-known too that these inclusions in the Kurloff-body may have the form of long, coiling threads; and this is a most important fact to bear in mind when considering the similar manifold forms of the "*Rickettsia*"-bodies, as these are found in different blood-sucking insects.¹

Now, in explaining the significance of the granules with which we are at present concerned, it is essential to remember that, whether we have regard to nuclei which are still normal and compact, or to those which are beginning to break down, the nuclear material thus stained dark red (or reddish-purple) does *not*, certainly for the most part, consist of chromatin. In a Giemsa-smear, as ordinarily made, the whole nucleus stains in general almost uniformly. To see what actually is chromatin, recourse *must* be had to wet-fixed films, stained with a recognized chromatinic stain.² In a normal nucleus, the bulk of this red-staining material (after Giemsa) consists of the plastin-constituents, nuclear framework, karyolymph and so on; i.e., of proteid substances other than chromatin.

¹ Jonesco-Mihaiesti has recently described (*C. R. Soc. Biol.*, 84, 1921, p. 1014) a fatal disease of guinea-pigs, originating from a louse infected with typhus, which he considers was caused by a filter-passing virus. From the particulars and charts given, this may have been a form of typhus. It is most interesting to note that the author points out that one characteristic feature was the increase in number of the Kurloff-bodies; another indication that hæmatophagy and hæmetaboly are at work to an unusual extent.

² The remarkable difference in the appearance of the nuclei, e.g., of leucocytes, when stained by these two methods, respectively, will be also apparent if reference is made to figs. 10 to 12 of my first paper.

And as regards these nuclei undergoing lysis, what chromatin they originally contained has become decomposed, as we have seen; moreover, the material from which the majority of the granules and small masses, now dispersed through the cytoplasm as a result of the lysis, have been produced was, in the first place, not chromatin, but some other proteid substance, which has itself probably also been "broken down" or degraded in the course of the digestion. This is why, therefore, these granular elements—unlike bacteria, which contain chromatin—do not stain with a nuclear stain such as iron hæmatoxylin. And this case affords, I think, an excellent illustration of the dangers of regarding granules which stain

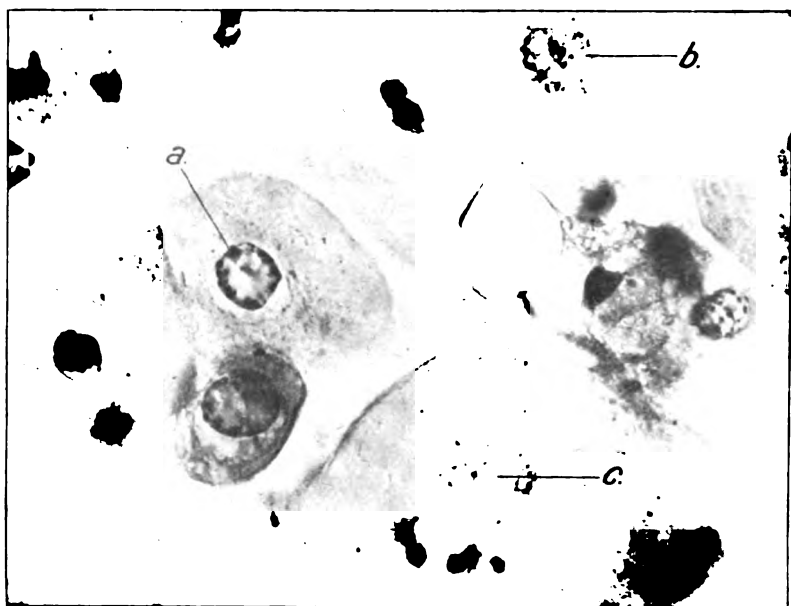


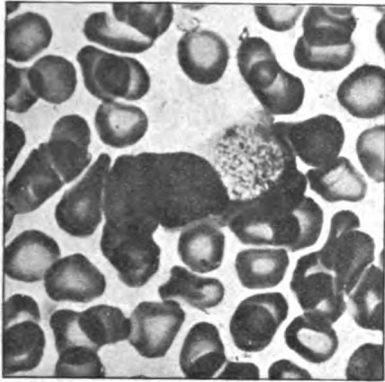
FIG. 9.

red with Giemsa as consisting of chromatin and being therefore of the nature of living organisms. For the above reason I think this lytic process is better termed karyolysis than chromatolysis; the former term includes the latter and, in addition, the breakdown of the general nuclear material as well.

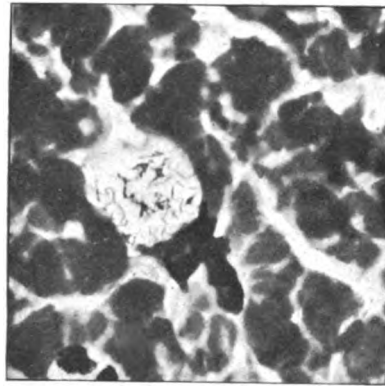
Of course in many, if not all, the various cases to which reference has been made, these protein particles probably have a different chemical constitution, whatever this may be. But regarding them in general, whether they result from the digestion of hæmoglobin or of nuclear material¹, it is seen that they possess two or three characteristics which

¹ The same type of particle may result from the digestion of both these types of organic material, e.g., in the case of the formation of platelet-granules and probably also in that of the "Rickettsias"; it all depends upon the particular enzyme at work.

are most apt to be misleading. They stain red with Giemsa, thus inclining one at first to regard them as composed of chromatin; they have a disconcerting morphological definitiveness; and in some cases they may show an individual variation in form which is remarkable. Nevertheless, I repeat, as regards those types which I have considered, I can see no reason for considering them to be living elements, whether "Chlamydozoa" or "ultra-microscopic" organisms; but, on the contrary, every reason for regarding them as products of the digestion of organized material.



(A)



(B)

FIG. 10.

A CONSIDERATION OF THE GENERAL QUESTION.

Therefore, with all deference, I wish to ask Colonel Gordon whether the granules he describes are not the discernible end-results of a similar process of cell-lysis? In the field reproduced by Gordon in his fig. 2, from a smear of nasal secretion at the onset of influenzal catarrh, showing the alleged minute filter-passing organism, there is much broken-down cellular material and, in addition, a regular series of transitional stages from larger, more deeply staining grains down to the most minute granular specks. To me this appearance seems perfectly comparable with that in my fig. 8. Since, in ordinary naso-pharyngeal secretion, there are any number of similar particles, which do most certainly result from karyolysis, there must surely be the same to be found in the nasal secretion during influenza, because cell-destruction is also taking place—probably, indeed, on a greater scale. How, then, can Gordon *distinguish his filter-passing organisms from such non-living, protein particles?* Is it not much more likely that all the granules seen are of this latter nature?

Similarly, in Gordon's fig. 4, of a preparation of fresh calf-lymph, diluted, there is the same variation in size and appearance. Here, again, it is not possible to separate the smaller forms, at any point, as a definite

"ultra-microscopic" organism. If there had been many staphylococci (or other cocci) in the field, would most of them have been of different sizes? Moreover, it may be pointed out, in the case of both figures, many, at any rate, of the granules are distinctly larger than either platelet-granules or than the smallest "Rickettsias" which have been figured (*e.g.*, by Wolbach, Todd and Palfrey).

As regards these lymph-granules, I think they are derived from two sources: in part, from the ultimate destruction of the epithelial cells (as in the case I have been considering); and again, in part, from the inclusions in the vaccinia-bodies (Guarnieri's corpuscles, etc.), representing the ultimate particles into which the ingested and altered corpuscles and cells eventually disintegrate; in other words, the minute "initial bodies," "gemmules" and soon, of the "Chlamydozoan" school. Similar granules would most probably be found, for instance, in the virus of hydrophobia; compare the minute granules into which the Negri-bodies finally break down, according to Negri.

The more attention is focused upon them, the more numerous are the cases in which these red-staining bodies or particles are being found in various diseases of unknown causation. Some time ago Colonel Harvey kindly drew my attention to a short note by da Fano (*Brit. Med. Journ.*, October 22, 1921), in which the writer pointed out the occurrence of "bodies," certain forms of which strikingly recalled Negri's bodies, in *encephalitis lethargica*, and since then, Levaditi, Harvier and Nicolau have published a description of these (*Ann. Inst. Pasteur*, xxxvi, 1922, p. 63).

Once let it be realized, as I most firmly believe it will come to be, that all these inclusions and granules are in reality substances resulting from the lysis of various cellular elements, we shall be confronted with two facts. One is that, so far, no genuine "ultra-microscopic" living organism has yet been detected; the other is that, in all these cases, some pathological ferment action is concerned. And this latter point is, I think, of the utmost importance in regard to the elucidation of the *ætiology* of these diseases.

It will be remembered that, in my first paper, I made use of this significant point as an argument in favour of a view I put forward that the cause of these virus-diseases may be a ferment or enzyme: and I adduced the most interesting phenomenon of the "bacteriophage" of d'Herelle in support of my view. This phenomenon is, I think, much more correctly called the Twort-d'Herelle phenomenon, in the same way that the Leishman-Donovan bodies are so known. In spite of all the experimental evidence regarded by d'Herelle as conclusive of the occurrence of a parasitic, ultramicroscopic organism producing this phenomenon, the general view, I gather, is strongly in favour of a bacteriolysin—a bacteriolytic enzyme. And the more I think of this case, the more I consider that we have here a valuable "line" to guide us in regard to the filter-passing and "ultramicroscopic" viruses.

Just as I have quite recently pointed out how essential it is to remember that tissue-cells are fundamentally comparable with protozoan individuals, so it is equally necessary, I think, for us to bear ever in mind the elementary fact that all living matter (protoplasm) is fundamentally similar; whether it be the lowliest micro-organism or the most highly differentiated tissue-cell. Hence I do not think there is any reason to doubt that widely differing forms of living element may, on occasion or as a special development, exhibit similar vital attributes, whether of doing or of suffering. We know, for instance, that certain of the venomous snakes can produce, from special cells, a toxin as virulent as that of any microbe. Again, some most interesting work has recently been published by Turro (*C.R. Soc. Biol.*, lxxxiv, 1921, p. 434 and preceding references), showing that extracts of the cells of various tissues contain bacteriolytic ferments; hence the author concludes that the polymorphonuclear leucocytes (the microphages) are by no means indispensable for the destruction (digestion) of bacteria in the body.

Now it is particularly with reference to the *mode of increase* of the ferment-virus in these diseases that the example of the bacteriolysin of Twort-d'Herelle is so valuable. From what I have just said, there is nothing unreasonable in inferring that *there is a similar mode of increase by the tissue-cells themselves*, which are particularly involved in the different cases. Once the idea of a parasitic bacteriophage is abandoned, it is clear that the only other way in which the bacteriolysin can be increased so abundantly as to destroy culture after culture, is by the further production of this lytic enzyme by the bacteria affected. This means, inevitably, that (in all those cases where the process is started from outside) the addition of a most minute amount of the lytic agent somehow stimulates or otherwise induces the microbes in course of dissolution to produce more of this same "virus"—as it may be regarded, since it is assuredly "pathogenic" to the bacteria. And I have already ascribed an entirely comparable phenomenon, or mode of behaviour, to the tissue-cells in explanation of the increase in quantity of the ferment-virus in hæmatophagic diseases (*vide my earlier paper*).

When I wrote my paper I was unfortunately unaware that Twort, when first describing his phenomenon (*Lancet*, December 4, 1915, p. 1241), briefly mentioned the possibility that an ultramicroscopic virus might be "an enzyme with power of growth." An enzyme, however, I am informed on high biochemical authority, has no power of "growth," i.e., of increase *per se*: it can only be produced by living cells. And in his recent paper before the British Medical Association (*vide Brit. Med. Journ.*, August 19, 1922, p. 295), Twort goes a step further and now suggests, as an alternative, that this ferment-virus may possess the power of "stimulating the cell to produce more pathological enzyme." I am very pleased to see, therefore, that Twort here recognizes the possibility of the very view which I myself have advocated, basing it upon the evidence of the occurrence of abnormal hæmatophagy.

With the instance of the bacteriolysin before us, I think this is a perfectly valid explanation; and hence, unless or until it is *proved* that among the various "bodies" and granules in question, whether they happen to be minute enough to pass through a filter or not, some are actually capable of growth and multiplication, it cannot be said positively that any living organisms are present. In my view, *the evidence available is markedly against there being such*. One little point mentioned by Twort (l.c.) is most suggestive. On examining the translucent or "glassy" areas in his cultures, where the lytic process had killed the micrococci, he found that "nothing but minute granules, staining reddish with Giemsa, could be seen." Have we not here, again, the same old type of granule—the residual protein particles of the digestion of the bacteria? Or would they be regarded as the parasitic bacteriophage, liberated by the dissolution of the micrococci? I doubt very much whether this view would arouse enthusiasm; but it is really just as likely—or unlikely—as that which would regard these other minute granular elements as living organisms!

Nevertheless, these granules and bodies are extremely important. Take the case of diseases regarded by me as due to hæmatophagy and attempted hæmetaboly; for instance, the exanthemata, hydrophobia, typhus, and so on. I have already laid stress on the point that the particular formations found, of whatever type they may be, "stand in some fundamental pathological relation to the disease" (l.c., p. 427). *They are inevitable witnesses*; even Sergent, Foley and Vialatte, in a paper on the "Rickettsias" in lice (*Arch. Inst. Past. Afrique Nord.*, 1, September, 1921, p. 217), suggest that, if these do not constitute the virus itself of typhus, they may, nevertheless, be "des microbes 'témoins' qui 'accompagneraient' le véritable agent infectieux invisible."

Thanks to a most useful suggestion which my friend Dr. Ledingham made to me in course of conversation, I now think that these various bodies and granules, though not micro-organisms, do indeed themselves indicate the virus; that is to say, they represent the only objective manifestation thereof which we can at present obtain. Speaking about the bacteriolysin, Ledingham pointed out that the ferment or lytic principle was most probably in some manner attached (or absorbed) to minute colloidal protein particles, which would thus convey, as it were, the actual agent. Similarly, I consider that, in the case of these animal viruses, the pathological enzyme is in all probability attached to and conveyed by the proteid bodies and granules representing the end-result of the breaking-down process.

In another respect, certain facts now known in connexion with the bacteriolysin are most helpful. When I wrote my first paper, I recognized there was one difficulty in the way which I could not explain; namely, as to the production of antibodies and immunity, because it is stated in many text-books that there is no satisfactory evidence of the occurrence of anti-enzymes. Now Bordet and Ciuca have shown that, after injections of

the bacteriolytic principle into animals, an antilytic serum is produced; in other words, antibodies are produced and the action of the bacteriolysin is inhibited. Whether antibodies are formed to the protein particles carrying the enzyme, or however the reaction is produced, the main thing for my present purpose is the fact that a (temporary) immunity to the pathogenic action of the bacteriolysin results. Hence, the production of immunity to ferment-virus diseases can be regarded as occurring in a similar manner.

Levaditi, as a result of work by himself and collaborators, has recently attempted to classify the various diseases of hæmatophagic character, to some of which I have referred, by showing, in a most useful manner, their relation to cells of a particular embryonic layer and to particular types of tissue. Thus most of them are termed ectodermoses¹ and regarded as dermatropic or neurotropic, according to the predilective tissue-site (*vide C. R. Soc. Biol.*, lxxxv, 1921, p. 425). The writer sums up the general characters of these viruses in the following enlightening sentence: "Il devient frappant qu'ils appartiennent au même groupe, puisqu'ils sont tous filtrants et invisibles, qu'ils se conservent à l'état sec et dans la glycérine, qu'ils se détruisent vers la même température, qu'ils n'ont pas été cultivés sur les milieux habituels, mais seulement en symbiose avec les éléments cellulaires (*in vitro*)," etc. Now, does not this *ensemble* of characters suggest more than anything else a ferment? Gordon himself also admits, at the commencement of his paper, that the properties possessed by the filtrable viruses are "somewhat different from" those of "the ordinary pathogenic bacteria; thus, while the resistance to heat of these viruses is lower, their resistance to glycerine is very much higher than that of most bacteria."

In this connexion, I was much impressed by some words of Dr. Ledingham, spoken at the recent meeting of the British Medical Association, in reference to d'Herelle's "bacteriophage" (*vide British Medical Journal*, August 19, p. 297): "I should desire to be satisfied that the alleged cause was a *vera causa* in the sense of the old logicians—that in fact it was a cause which did not tax too severely one's sense of the naturalness or likelihood of things." Just this very same argument I would apply to the case of these alleged filter-passers. In order to support the view that they are living organisms, it is obviously going to be necessary—indeed, Gordon himself throws out hints in this direction—to postulate not merely a new type of organism, *but a form of living matter, differing in certain fundamental respects from the protoplasm of the lowliest micro-*

¹ I may point out in passing, that typhus would be an example of a *mesodermic hæmatophagia*; and various other fevers may come in this group, e.g., trench-fever, Tautsugamushi-disease or Japanese river-fever, and so on. This group will probably be characterized by the general minuteness of the end-products of the unusual hæmetaboly on the part of the vascular tissue; in contrast to the more distinct "bodies" associated with the ectodermoses, or *ectodermic hæmatophagias*.

organisms—i.e., a thing of which we have, as yet, no cognizance. Of course, one does not wish to deny that anything is possible: still, if the phenomena in question are capable of reasonable explanation along the lines of the known biological behaviour of admitted living elements, such an explanation does not tax my own personal sense of the likelihood of things nearly as much as one which involves the assumption of the existence of a new kind of living matter.

Now, I would particularly direct attention to the point that these viruses can be "cultivated" only in *tissue-containing media*; because I think this qualification explains the successful cultivation, i.e., the increase in amount of the active principle, as indicated by the further production of granules—the alleged "ultramicroscopic" organisms. A process takes place entirely comparable with what is seen in cultures in which the bacteriolysin is acting. That is to say, such a culture contains both ferment-virus and cells—either tissue-cells (usually), or blood-cells (leucocytes), or even vegetable cells¹. And, just as in the bacteriolytic process, so in this case under suitable conditions, the pathological enzyme will stimulate the cells to produce more of itself, the cells at the same time undergoing lysis to a greater or less extent. As a result, more protein granules, end-products of the digestion, will be met with in the culture, particularly, as Gordon himself points out, in the neighbourhood of the piece of tissue. Further, I think that the process of digestion and the increase in quantity of the granules may very likely take place also in a medium containing complex proteids, for instance, an egg-medium; but here, as there are no cells, the virus, regarded as an enzyme, could not itself be increased; and it is to be expected that such a "culture" could not be freely sub-cultured, but after a few "sub-cultures" would fail—go off, as the ferment became too greatly diluted.

THE CASE OF INFLUENZA.

I venture to suggest that the general thesis which I have tried to indicate is capable of extension, and in such a manner that it may be usefully applicable to the case of influenza. As above mentioned, Turro has shown that extracts of different tissues have a bacteriolytic action. And it is most probable that, in the recent work which has been done upon the bacteriolysis of certain intestinal bacteria (e.g., *Bacillus coli*, *B. dysenteriae* Shiga, etc.), the origin of the bacteriolysin in the filtrate of the intestinal contents used, has been from certain tissue-cells themselves. This means therefore, that a lytic enzyme originating from tissue-cells can be further produced in "series" by bacterial cells, *without any subsequent intervention of the tissue-cells*. May not then the converse proposition be true, having regard to what I have said above? I mean, I think it is quite likely that

¹ I consider that in certain diseases of plants, e.g., mosaic disease, we may have also to deal with a ferment-virus, and corresponding behaviour.

in certain—it may be special and limited—cases, a particular type of cytolytic ferment produced by a micro-organism (and representing its toxin?) may stimulate or otherwise cause *particular types of tissue-cell to produce more of this same ferment*, in the course of their own lysis; and thus cytolysis, once started, may be progressively continued, *independently of the micro-organism*, or associated micro-organisms, which originated the process. It seems to me that, if such an action takes place in influenza, some of the difficulties in the way of regarding a known, incriminated micro-organism as the causative agent may be explained.

In the first place, if the tissue-cells involved are in a particularly susceptible condition, a slight infection with the micro-organism might thus entail cytolytic effects on a scale far greater than appears commensurate with the small number of the organisms to be found; just as the merest trace of bacteriolysin can ultimately destroy a whole culture of susceptible organisms. There is another point; and I think this is of considerable importance in relation to the work of certain observers (e.g., Olitsky and Gates), which is regarded as being strongly in favour of a distinct filter-passing “ultramicroscopic” organism. On this view, of progressive auto-cytolytic action by a ferment, originating, to start with, from a recognized microbe, “cultivation” and further production of the ferment, granular end-products of the digestion and so on could take place in media, *containing a suitable cellular element, which had been inoculated with filtrates of secretions from which the actual causative organisms had been eliminated*; in other words, “cultivation” of the cytolsin could go on, in the absence of the bacteria, just as “cultivation” of the bacteriolysin can go on in the absence of the tissue-cells, which have first produced it.

Moreover, once this auto-cytolytic action had been set in train it might be transmissible through series of animals. Indeed, certain animals might be more susceptible to this “virus” thus immediately derived from tissue-cells, than to inoculation with the specific organism, which might never gain a hold.

In conclusion, I am very sorry to say that I am quite unable to agree with Gordon that “search for the primary infective agent in influenza . . . has led us into the realm of filter-passers, and has revealed the presence of a micro-organism of this group.” It is hardly necessary for me to add that some most eminent authorities are satisfied that classical influenza is caused by *B. pfeifferi* and consider that the recent severe pandemic may have been the result of the combined pathogenic action, under unusual circumstances, of this and other dangerous organisms, e.g., *Streptococcus hemolyticus*. But I may point out that Professor McIntosh, for example, in his recent Report to the Medical Research Council, does not scruple to reject *in toto* the view that a filter-passing organism is concerned, and contends that the minute bodies observed in cultures of filtered material derived from influenza-cases have not been differentiated with certainty from inanimate

particles present in all albuminous fluids (*British Medical Journal*, July 22, 1922, p. 137).

Dr. Arkwright, regarding the matter from the standpoint of a bacteriologist, has recently shown (*British Medical Journal*, 1919, ii, p. 233) that the claims of one alleged filter-passing organism to be the cause of influenza are untenable. And, from the standpoint of a microscopist, I think I am entitled to say—since the question is largely one of the interpretation of microscopical appearances—that I consider the filter-passing granules described by Gordon are perfectly comparable with the granules, staining red with Giemsa, which, as I have shown, are produced in any number as a result of karyolysis, in the breaking down of cellular elements. I have thought it useful to point this out, because, as one who has regularly been using the Giemsa-stain for over sixteen years and knows full well its dangers, it is my strong opinion that the view that all these various red-staining granules and bodies are living organisms is one which will *seriously impede* the true progress of medical science.

EXPLANATION OF FIGURES.

(FOR DESCRIPTION, SEE TEXT; ALL FIGURES ARE $\times 1,000$.)

FIGS. 1–9.—From naso-pharyngeal secretion, at a time of no cold or influenzal attack. (Unfortunately, the figures from Giemsa-stained preparations suffer unavoidably from the absence of the colours. In spite of Mr. Dennis's skill and numerous efforts, the contrast between the breaking-down nuclear masses and the micro-organisms does not appear nearly as great as is actually the case. It would mean the sacrifice of the finer granules to obtain detail in the denser parts. Figs. 1 and 5 are a compromise in this respect.)

FIGS. 1–3, 5.—Epithelial cells showing different stages in karyolysis. Giemsa.

FIG. 4.—From half of a dried Giemsa-stained smear, which was de-stained and then re-stained with iron-haematoxylin; epithelial cell, the nucleus of which has lost much of its chromatin, the nuclear mass appearing greyish: lying on the cell are numerous, intensely-stained bacteria.

FIG. 6.—Epithelial cell in which karyolysis is complete. Numerous bacteria present for comparison. Wet-fixed film (subl.-alc.-acet.); iron-haematoxylin.

FIGS. 7 AND 8.—To show the end-products of karyolysis disseminated in the general matrix. Giemsa. (This smear was the fellow-half of that used for fig. 4.) In fig. 7 a few scattered diplococci are also seen, but in fig. 8 no micro-organisms are present.

FIG. 9.—Epithelial cells to show: (a) Normal nucleus; (b) nucleus in course of breaking down; (c) almost complete karyolysis. Wet-fixed film; iron-haematoxylin.

FIG. 10.—Peripheral blood of guinea-pig, showing Kurloff-bodies in lymphocytes. (A) Inclusions in the form of granules; (B) inclusions in the form of minute bacillary rods. Giemsa.

FRAGMENTS.

BY COLONEL SIR ROBERT FIRTH, K.B.E., C.B.

XXXI.

A FEW evenings ago, I was at a theatre and laughed so much that I cried. It is curious why two apparently antithetic emotions, laughing and crying, should be associated, and equally curious to note how little attention the association has received. Physiologically, laughter seems to be caused by the sudden liberation of a temporarily increased accumulation of central nervous energy, which seeks to discharge its whole force at once, especially through the outlet of the throat and mouth, in a succession of gradually diminishing shocks or shakings. This is said to explain why there is vascular congestion prior to the laugh and the blood resumes its normal flow after the laugh has taken place. Antecedent to a laugh, the whole organism is raised to a higher pitch of vitality, and when the laughter dies down there is an intense organic sensation of relief. Just as laughter is an emotional utilization of the function of breathing, so weeping is an emotional utilization of an organic function of lubrication. Development has brought this about and only experience can discover the connexion between mental states and bursts of sound on the one hand, and an unusual flow of lubricating fluid from the tear gland on the other. The cause of weeping seems to lie in a sudden lowering of vital energy which reverses its primary tendency and turns the energy of the organism inwards instead of outwards. This disturbance finds expression in effusions of the lachrymal gland, and gradually by a series of convulsions leads to a general collapse of the organism; in this lower state its equilibrium is restored and rises again. The contrast between laughter and tears on their physical side is both familiar and instinctive. In laughter we have a sudden heightening of the vital energy of the organism; in weeping a sudden arrest and lowering of the normal outward flow of energy. Both are forms of restoration of equilibrium and both are forms of expression of organic energy, and hence both terminate in a state of relief from nervous tension. In the case of laughter it is the restoration from a heightened potential and the relief of a free expansion; in weeping it is the restoration from a lowered potential and the relief from prolonged repression.

It will be conceded that mind is inseparable from the bodily aspects which are the expression of the emotions, and that the significance and main interest of the emotions lie primarily in the mental process which they involve. The question arises, therefore, into what conscious factors can we resolve the consciousness of the laughable on the one hand, and the tearful on the other? Before laughter can arise, we must be aware of something to laugh at and this is tantamount to saying that, in all situations

of the ludicrous, some judgment is formed in consequence of which a laugh ensues. If laughter arises which does not reveal this condition, we say the laughter is absurd, hysterical or meaningless, and condemn or pity it. We condemn if it does not fit into the context of our experience, we pity if such laughter has the appearance of the unconsciously irrational, since no one can enjoy when there is no object of enjoyment. This condition is important and significant. Whether it be a child or an adult who laughs there is ever a short interval between the consciousness of a situation and the judgment passed upon it which results in the laugh. When a given situation is presented to us, our initial interest in it is a matter-of-fact interest, and at that stage there is no difference between our apprehension of a situation which turns out to be amusing and our apprehension of any other fact. Now when our interest in a situation is solely of this character we do not laugh, we merely understand and this is so complete that it brings a pleasure all its own. This explains why people whose interest in things is limited to understanding them display no sense of the ludicrous, and the incapacity to see a joke is synonymous with too great an anxiety to understand; for the like reason it is both dangerous and difficult to explain a joke. Undoubtedly, the better we understand the less superficial our laughter, and perhaps on that account the more rarely some people laugh; but superficial laughter is often but the correlation of superficial understanding and, fortunately, profound understanding is often accompanied by a keener appreciation of the ludicrous. The argument, therefore, is that apprehending a situation does not by itself create laughter but preconditions it by preparing the ground for another way of looking at the situation, and this further interest, as distinct from understanding, is appreciation; and since laughter does not issue upon mere understanding, it may be due to an operation of the process of appreciation.

Admittedly, laughter is no respecter of persons, places or things. Each one of us, at times, has felt a difficulty in suppressing a laugh at some stage of a solemn festival and even the pomp and circumstance of death is occasionally not unfertile in provoking a smile. Certainly, there is no particular end or result which calls forth laughter, but the same end may or may not produce laughter according to circumstances. There are two ways in which facts may stand in relation to an end or result in view. One way is, the facts may be so carefully planned and arranged that the end is reached successfully, step by step. When this happens, we do not laugh; we simply either accept the achievement, or praise and admire, or we feel angry and disappointed if the end achieved be one which destroys some previously accepted scheme of good. In the other way, the end may be neither reached nor abandoned, but the relation between things and the end in view is incoherent, disconnected and irrelevant. In such a case, the end though neither accomplished nor defeated remains secure in spite of the incoherence and, since the facts and the end stand in a real relation to one another, we assume a mental attitude towards the situation which

results in laughter. We laugh because the character or process of an object which is considered to refer to an end is judged to be incongruent with the result or end in view. The only qualification demanded is, that the object or its process must point to the result or end and the end must continue to claim a control over the object, neither factor disappearing. If, for any reason, we lose sight of either of these factors, no laughter ensues. Therefore, we can say that a situation is rendered laughable by virtue of incongruity and contrast. The incongruity is specific, because every kind of incongruity does not conduce to laughter. When a man is overwhelmed with disaster after struggling against odds, there is incongruity, but the situation is the reverse of laughable. Similarly, when two ideas clash we have incongruity, but the situation causes irritation or disappointment and no laughter. Mere contrast, again, is not the essence of a laughable situation. The world is full of contrasts which evoke no laughter but often lead to tears. Like the incongruity, the essential contrast is specific and the particular kind of contrast which starts laughter is the contrast between the incongruous process and the end sought. This element of contrast is partly the source of the surprise which is felt in so many laughable situations, though not in all ; neither need it be sudden.

An illustration may give concreteness to the above statements. A frail old man is seen vainly chasing his hat down the street in a high wind. The orderly connection between the object and the wearer to maintain his comfort has been broken, with the result that the old man is discomfited. Except to the ill-disposed, the situation suggests pity rather than laughter. If we substitute an over-dressed young fop for the old man, it is otherwise. In this case, the breach in the orderly connection between the object and the wearer affects the fop's dignity, the object makes off regardless of its place in the purposes of the fop's life, the fop insists on the relation between himself and his hat being maintained, while the hat as obviously disowns the relationship. Neither can get rid of the other, and yet both are for the time being incongruent with each other, the fop's dignity with the position and behaviour of the hat and the hat with the feelings of the fop. As no injury results to the fop, the situation impels to laughter. Other examples of the laughable are afforded by acts unintentionally incongruous with the end in view, such as a beginner trying to skate, a man making his first speech in public and a novice attempting to speak a foreign language. As in the unintentionally laughable acts of the unskilled, so laughable situations can be and are created by those in the possession of skill. This is frequently exercised in the manipulation of ideas and words symbolizing ideas. Familiar types are what we call *wit*, which consists in suggesting a truth either by bringing out a similarity between incongruous ideas or incongruous differences within the same idea. It is the same with *puns* and amusing conundrums which are forms for the artificial creation of laughter out of ideas and words.

Social life affords a rich field of the permanently laughable. The

reason is that here we have on the one hand well-established ends towards which human life is directed, and on the other hand a complex range of detail which is drawn from Nature and Humanity but subordinate to those social ends. The laughter producing situations may be either isolated and momentary, or be so complex that it takes weeks, months, or years to reveal themselves in all the extent of their laughable character. The occasional behaviour of a *nouveau riche* or an office boy creates laughter because the end to be attained is confronted with an agent mentally and physically incongruous with the demands made upon him; he does the inconsequent act and the irrelevant thing. Whether then, the situation be momentary or drawn out over a long time, the same principle operates in the emotion of the laughter to which the situation gives rise. There is a social end of some kind on the one side and, on the other, human actions which are incongruous with the ends accepted as standards of those actions. The incongruity may arise from Nature herself; it may arise through the acts of individuals; and it may arise from the inter-play of many individuals intersecting and thwarting each other at some points. How Nature upsets the calculations of men we all know, and how the interplay of human purposes in every comedy of errors makes havoc with the best intentions of the actors is familiar. It is bad enough when each of these sources of incongruity operates alone, but, when all work together, the wonder is not that comedy arises so often, but that any purpose is ever successfully and seriously carried out at all in social life. Sometimes the entanglements may be so serious for the agent that he can laugh only when the end has triumphed, and his laughter arises from the appreciation of how the end stands out in contrast to the incongruity of the process. The social purposes controlling individual lives have varying degrees of importance; some are trivial, some are fundamental. Hence we have comic situations which are merely on the surface of social life and others which go down to its depths. These last are the source of the higher dramatic forms of comedy; the former give rise to farce.

The characteristic of higher comic drama is that it seizes on vital ends of social welfare. It is not this which creates the laughter; the laughter arises from the incongruity displayed by the actors in their efforts to secure an unfulfilled end, or one attained almost in spite of their efforts. Hence while laughable situations are the material of comic drama, invariably creating laughter, the creation of laughter is not the sole purpose of a comic drama. In short, it is a planned arrangement of laughable situations, which is constructed on the assumption that the good end must triumph finally and satisfy the agent not simply in the sense of giving him all he wants, but in the sense that his life as a member of a given society finds the real good it derives when the end is attained. We see here the difference between the point of view of comic drama and a morality play. To the comic dramatist, the moral life is material which he works up into a plan of social existence, a plan which he sees to be

controlling the apparently rambling and disconnected actions of men ; the comic dramatist never teaches intentionally though he may be confident in his moral beliefs. On the other hand, the moral dramatist does not allow himself to be under the sway of social necessity ; he has his eye on an ideal or a good above the present and demands man's free choice and free judgment at all costs. If he uses laughter for his purpose, he does so through mockery and satire and then the laughter is directed upon the bad and the vicious and not upon the good and the virtuous. Each method can be used to good purpose, but, when we realize that it is in the treatment of the deeper and more universal social ends that we get the best comic dramas, we understand why it is that such laughter-provoking dramas make a universal appeal to readers or playgoers of every nation, and why the jokes of Aristophanes, Molière and Shakespeare appeal as forcibly to a Dutchman, a German, a Japanese, or a Chinaman as they do to a Greek, a Frenchman, or a Briton. It is but an example of how a touch of human nature can make kinship of the whole world.

There are several kinds of laughter, so much so that we can draw a distinction between good and bad laughter. This does not mean that there is a moral code in laughter, but that the judgment of appreciation from which the laugh starts may be wise or foolish and accurate or inaccurate. Since the laugh is always the spontaneous outcome of an individual's appreciation of a situation, it is true to say that a man's laugh betrays the kind of man he is, provided we mean that statement to refer to the laughter directed upon the good or bad ends of social life. It does not refer to all laughter, for laughter is not the outcome of character but of a judgment upon a certain kind of incongruity. The good and the evil ends of social life are equally able to start laughter, and to some minds the indecent and the incongruities associated with man's higher spiritual ends seem peculiarly able to excite laughter. This is what we might expect since there is no greater contrast than that between the high and the low, and nothing more incongruous. Further, the social standard of what is laughable will vary from society to society and from time to time in the same society. Things which our forefathers took seriously become objects of laughter to their successors, and situations which were amusing to them seem offensive or dull to ourselves.

Individuality counts for much where laughter is concerned. Laughter varies with the state of mind of an individual at a given time, indicating that the judgment of appreciation is different from the judgment of understanding. Hence the remark "a jest's prosperity lies in the ear of him who hears it, not in the tongue of him who tells it." In like manner, when a jester laughs at the situation he is narrating, he spoils his jest because he assumes too much and encroaches on the listener's right of private judgment of the case. Another curious thing about laughter is that the more a laugh is restricted to one or a few individuals, the more it tends to be depreciated. The social test is the best test of a laugh. The

bitter, the cynical and the hard laugh arise from some special personal interest and are rightly discouraged. Honest, healthy laughter rests on a judgment of an actual objective situation and is always detached from personal bias. It is for this reason that it is difficult for most people to laugh at themselves, and that, to enjoy laughter, the situation which prompts it must be remote from our own interest. At the same time, laughter is not less keen because it is conventional, for much laughter is the result of social education, habit and imitation. A curious confirmation of this is the fact that the mere facial expression of a laughing person often sets up, by imitative sympathy, the corresponding expression in the observer's, and we realize that, like some other things, laughter is infectious.

Laughter has certain levelling and socializing influences. We do not care to laugh with inferiors or with those whose society is distasteful to us. Laughter so breaks down the restraints of normal personal life that the free laughter of master and man, or officer and private, imperils well recognized lines of social demarcation. Conversely, it may be noted that because rigid social distinctions melt before the flame of laughter, so the opportune creation of a laugh is one of the readiest ways of overcoming an awkward situation in social life. In these aspects of the laugh, there is no question of superiority or inferiority, because laughter neither magnifies nor belittles the person laughing or the object of laughter. We can laugh at all things, be they small or great; for the laugh is not the result of calculation of weight or of importance, but of the sense of incongruity of a process or situation with end in view, no matter what the situation or end may be. If this sense of incongruity can be shared by others, besides ourselves, so much the better; such joint assurance plays a great part in enriching social intercourse and the situation itself seems more laughable because it is laughed at by several individuals. This explains why few care to laugh when they are quite alone, and still fewer care to laugh alone in a company. If we do the first, the impulse comes to seek others with whom to share the joke, and to do the second is to proclaim that our judgment is not ratified by the common intelligence of the group in which for the time being we find ourselves.

Having said so much about laughing, I would pass to consider the mental state which is involved in crying. There are elements of difference and resemblance between the two states. In both, we can pre-suppose a consciousness of some situation, and crying resembles laughing in that the mere understanding of the situation is not what creates the tearful mood; on the contrary, understanding often stops the flow of tears. Like much laughter, many tears are due to a one-sided or superficial understanding of a situation and this explains why children cry more than do those of maturer years. At the same time, complete understanding does not prevent tears, for they, like laughter, arise from an appreciation of a situation of a certain kind. Discordance appears to be an essential

element for the production of tears, when we make a judgment on a situation in the light of an end or result. While, in the case of laughter, the end remains undefeated in spite of the incongruity of the process of reaching it, it is otherwise in the case of tears, because the end is either actually defeated, or we think it to be, by some process that has proved definitely hostile. This mere defeat of the end is not the essence of the situation, since we do not always cry because an end has been frustrated but often increase our efforts to reach it. The essential element in a situation to cause tears to flow appears to be the admission that an end is finally lost and the allowance of that end still to control the current of our desires to attain or possess it, coupled with a recognition that the process that overthrew our end is incongruous with the object of our desire. If we recognize no incongruity, there are no tears; it is the same when the good lost is seen from a wider point of view, because we no longer feel the incongruity. Familiar examples are the more poignant grief on the loss of a young life, and the less poignant grief following the loss of those who have reached the full term of years. In most, if not all cases of tears, the end lost must be felt to be a great good and also desired personally; further, the intensity of the grief is accentuated by a sense of the futility of the effort spent in striving for the end. These, then, seem to be the essential elements in the situation in which crying occurs, the influence of each element varying in different cases and with different people.

I have laid stress on the fact that the end which has been frustrated in the situation productive of weeping is almost always an end affecting our own personal welfare. We weep for our own losses and rarely for those of other people. Thus, the range of tears is much more restricted than the range of laughter, and the individual insularity of tears contrasts strongly with the social character of laughter. People in sorrow prefer to be alone because each heart knows its own bitterness, and yet to weep in sympathy or to have others weep in sympathy with us certainly softens the bitterness of tears. With this essential isolation of the individual in the weeping mood is associated the feeling that tears mean weakness or womanliness. So great can be this feeling in some men that no loss seems able to move them to tears. The reason is probably social, but varies curiously in extent and occasion with racial characteristics, national custom and personal temperament. While the ends involved in the weeping situation are primarily ends affecting personal welfare, it is curious to note an interesting complication wherein, by an easy mental transition, some can pass from weeping at the loss of their own individual desires to weeping at the loss of those of someone else. The explanation is because the desires or end of the other have been so closely identified with our own that we fail to distinguish the two. Sometimes, the process which has brought about a frustrated end lies outside of ourselves and is due to the actions of others; in such a case our helplessness adds bitterness to our tears and we

feel overwhelmed. Sometimes, the process was largely in our own control ; when this happens we are filled with a regret or self-blame which intensifies the emotion arising from the defeat of our purpose. A typical example of this is when people weep for their sins or wrong-doings. In this case, they do not cry because they blame themselves, they cry because they appreciate that some good end has been frustrated by their own actions and this frustration is their loss. Hence, the tears of a penitent are really the beginnings of a reformation of character. Another curious thing about tears and crying is, that we never weep over a situation which is incompleated. There is a sharp contrast between tears and laughter, for in laughter the end is secure though the issue is in the balance ; in weeping, the issue is settled, and consequently we weep only over what is regarded as past, never over what may be in the future. It is the past in its bearing on our present desire that is of importance in tears or crying, and as the past fades away from us it ceases gradually to trouble ; new ends arise which are effective and they replace the old. So much may this be the case that we may even be amused at what we formerly wept over. It is because the situation causing tears involves a finished result that, in the emotional state of weeping, the individual nearly always has a sense of resignation as to a kind of fate against which it is useless to strive. This sense of fatefulness arising out of a finished situation is the point of contact between the true tearful situation and tragedy in the strict dramatic sense.

Before discussing this complex mood, it is necessary to remember that sometimes the ends or results in relation to which tears arise are not clearly before our minds ; they well up from we know not where nor why. Familiar instances are the moods, often associated with half-unconscious lachrymation, produced by unusual beauty in poetry or by certain strains of music. There may be memories stirred up, but what happens, generally, is that, underlying the loveliness that meets the eye or ear, there is a sense of the Destiny controlling the transitory purposes of our individual life. We are conscious that the something which moves us rests upon a masterful necessity greater than ourselves ; our mood is a compound of a sense of pathos and a feeling of fulfilment. The fulfilment gives us a gladness and the pathos carries us to the grim depths of awe. In such mood, the individual feels himself overwhelmed, and his selfhood seems to disappear and to melt away into the impersonal being of the world. Herein lies the clue to the connexion between weeping and tragedy. I have endeavoured previously to show that comedy is really a dramatization of situations which are laughable owing to the incongruity of a process with an end or result which triumphs over all obstacles. Now, in tragedy, there is a corresponding dramatic development of the tearful situation. The essential difference between comedy and tragedy is that, in comedy the issue is at first in suspension, and in the second definitely realized ; whereas in tragedy, the issue is not in suspense but the end done away

beyond recall or modification, but, while the process was taking place, there was some possibility of the good or end desired coming through safely. When the end desired is precious, such a situation is unintelligible to the individual and all the more so because the process or sequence of events which thwarted the end may have been inevitable from point to point. The individual, faced with such a situation, feels that his individual human purpose is not merely at the mercy of agencies which thwart him, but also that he is impotent to prevent or alter their operation. This is more or less dimly appreciated in every situation which gives rise to tears.

It is not difficult to pass from what has happened to what may happen; and when this conception of things is grasped and worked out in a consecutive plan of action, we have tragic drama or tragedy. The essence of the tragic situation is that the course of events can and does, in obedience to either natural laws or human conditions, take a direction which frustrates the most treasured desires of the individual or even overwhelms the individual himself. The tragic dramatist knows the underlying principle, selects a situation and gives it articulate and intellectual expression. Shakespeare is full of examples. In *Macbeth* and *Julius Caesar*, it is the legitimate but overstrained aims of individuals which are overthrown and which overthrow the persons themselves; in *King Lear*, we witness the tragic overthrow of normal and healthy purposes and we feel the tension and the pathos as the situation makes them reach the highest point. It is the same in all ancient and modern tragic dramas, the most poignant being those where the very action of social forces, which make for the welfare of the individual, are so arranged as to bring about the overthrow of his aims and of his personality. To be overthrown in obeying these is indeed to be overwhelmed. We must not, however, suppose that tragedy presents a series of opportunities of tears for the spectator; the difference between the tearful situation and the tragedy lies in the conscious absence in the one case and the conscious presence in the other of a scheme of events which leads steadily on to the final result. Just as true comedy is more than a succession of ludicrous situations, so tragedy is more than a succession of tearful situations. The success of a tragedy depends on the degree in which the dramatist can portray the steady inevitableness of the issue. Similarly, it is no more the business of dramatic tragedy to educate by creating pity or fear than it is the aim of comedy to give moral lessons. Both tragedy and comedy, quâ drama, are outside the sphere of morality, the point being that the emotions of pity and fear are those awakened by the tragedy, just as the emotions of gladness or satisfaction are the necessary outcomes of a successful comedy.

Mirth and laughter have their appointed places and functions. *Desipere in loco* is not merely excusable; in due measure it is a bounden duty. In a word, healthy laughter is the salt of life because it lends savour to much

that without it would be stale and flat. Laughter too is a social exercise, and the man who laughs alone, being unable or unwilling to share with others the secret of his enjoyment, is deservedly unpopular. True, not every kind of laughter deserves the name of healthy. "Homeric" or clumsy laughter comes down to us through the ages as having nothing heroic or healthy in it, because the laughter of the Olympian gods was provoked by the clumsy movements of their lame colleague Hephaestus. Laughter of that kind has no place in present-day sportsmanship. We do not laugh at weakness, unless it be our own. There is no better cleanser of bad blood than laughter, nor a better solvent of fear. It so becomes, not from any ignoring of difficulty and danger, but from placing difficulty and danger in right perspective. The truly brave man is he whose sense of humour, no less than his other faculties, is heightened by approaching crisis. Let us ever remember that, if it is ill jesting with an aching heart, it is no less true that the heart aches much less for the jesting. The man who can laugh in emergency is of the band of happy warriors who never doubt that the clouds will break and who, in consequence, are able to greet the unseen with a cheer.

The question suggests itself, what is the mental value of laughter and tears in the economy of human experience? There seems to be no warrant for regarding them as pathological in any sense of the term, although I have been told by a doctor that both laughter and tears are states of mental disorder, much in the same way as genius is but a form of insanity. Neither can I accept Bergson's view that laughter and tears are but illusory apprehensions of actual human situations, because if there is anything we are sure of it is that our laughter and tears are no illusion to ourselves, but intensely vivid experiences, and nothing can shake us out of our laughter or tears except the change of our appreciation of given situations. All emotions are real while they last; our appreciation of situations may be mistaken and laughter or tears may arise from the mistake but the laughter or the tears is justified by the appreciation. As already pointed out, the essential is that the situation must be appreciated and judged in the light of an end to which the process or material involved in the situation stands in the relation of incongruity. The plain truth is that neither laughter nor tears can be squared with any philosophy, but rather facts upon which philosophy must be based.

This may seem unsatisfactory to those who assume that everything must and can be explained; but it is really very satisfactory to know that there are some things which are such as cannot be explained, which are good in themselves and not as helping us merely to some other good. For if everything was good only as it helped us to some other good, there would be no good at all but only aids to a good that did not exist. Our delight in a joke is really a delight in a final good and an ultimate pleasure in something that cannot be explained. Some would say that it is a delight in the irrational, but that which is good in itself is not irrational nor is our

enjoyment of it irrational, it is merely immediate; and the people who suspect and try to analyse immediate enjoyment are just those who cannot see a joke. They are always trying to see something else. We enjoy jokes for themselves; but there is also a subsidiary enjoyment arising from the recognition that the particular joke is indeed a joke. In this matter-of-fact world we are so involved in things that no one can enjoy for their own sake but only to be valued in terms of something else, that we lose the habit of immediate enjoyment and almost the belief in its existence, hence to realize that a joke is indeed a joke is as if we had seen an angel and thereby become convinced of the existence of angels.

There are some who say that humour and the laughter which arises from humour is associated essentially with an appreciation of imperfections. To some extent this is true, but humour is really a consenting to things that, without it, could not be consented to. Actually, it is a recognition or delighted acceptance of reality as a whole; the reality may be imperfect but all the same it is reality, and we enjoy and value humour because in humour not only do we accept reality but we say that it is better than any unreality could be. In this manner, humour is the state of mind that will not deny experience and, because it is experience that it recognizes, it delights in the diversity and incongruity of experience as representing the real and presenting the mark of reality. There is no question of humour delighting in imperfection, but when a joke is based on some imperfection we enjoy it all the more because our first enjoyment of it is a proof that we are accepting and overcoming the imperfection. Laughter exists because the comic exists and laughter is our answer to the comical much as art is our answer to the beautiful. For this reason there are varieties of laughter, all of them being man's answer to the eternal comic in the nature of things; thus, at one stroke, freeing laughter and the comic from their accidental association with malice. To be funny without malice is the civilization of the angels and it is only because we are clumsy laughers and seldom attaining to the power of disinterested laughter that there is malice in our jokes.

If the comical is but an aspect of beauty, and imperfection but a quality of ultimate reality, then, for those to whom reality is dynamic and our reality a true version of it, the comic being a true version and part of reality, laughter is the joyful recognition of the fact and the seeing of beauty in it. Those who have no sense of humour are devotees of a perfection that does not exist; they worship a cold idol in whose presence laughter would be a blasphemy, fearing laughter lest it destroy their idol. Again there are some who persuade themselves that laughter survives in us from our discreditable past and, with Freud, would have us believe that a joke is a means of releasing suppressed motives, usually sexual, from the unconscious and of giving them a harmless outlet. Doubtless, this may be a reason why many people enjoy improper stories; but these are people who enjoy the impropriety rather than the fun. The truth is, the nature

of laughter is not in its origins but in what it is trying to be ; it is our effort to rise to the level of the comic, much as art is our effort to rise to the level of the beautiful. Laughter is even more than this. It is our effort to adopt some attitude to a situation where a real incongruity exists or is felt to exist and so give it a place in our experience. We laugh at it and the laughter at once expresses its value for us and gives us the needed sense of detachment from what would otherwise be a situation creating serious mental perplexity. Hence, laughter is the note indicating that we have triumphed over the incoherent and that we have preserved ourselves in the face of the incongruous.

An analogous attitude is taken up by ourselves to a situation producing tears, and which actually presents an uncomprehended conflict between the course of events and our still desired ends. The situation is no illusion but a vivid reality, and we meet it by taking up an attitude which will keep our mental balance in the face of the environment which confronts us. In tearful emotion we meet the situation that spells the failure of our cherished purpose, by assuming an attitude which at once confesses our loss and at the same time sustains our mental unity by still clinging to the desired end. Something has foiled our purpose but cannot foil ourselves ; we succumb to a situation which admits of no intelligent reconciliation, and in order to express ourselves we break down into tears. This relieves the tension which has been created between us and our environment by the defeat of our desires ; this prepares the way for new efforts to realize new ends in spite of a temporarily hostile environment. Hence the curative effect of tears. Bearing in mind the apparent connexion between laughter and tears on the one hand, and comedy and tragedy on the other, we cannot be surprised that parts of the dramatic aspect of life and experience can come to light in the apparently fortuitous, but really inevitable, form of laughter and tears.

SENESCENCE AND SENILITY.¹

BY MAJOR R. J. C. THOMPSON,

Royal Army Medical Corps.

AND

MAJOR R. E. TODD,

Royal Army Medical Corps.

PROBLEMS connected with old age have interested all generations. From perusal of the literature on the subject, it would seem that certain general principles in dealing with the aged are well recognized, but in actual practice they are often forgotten or ignored. This paper, based on two years' collaboration at the Royal Hospital, Chelsea, is not intended to be a full scientific treatise, but a simple expression of what we believe to be the basic principles underlying old age and rational methods of retarding permanent decay. We have been in medical charge of a population of 500 veterans, averaging 73·3 years of age, with twenty-two per cent aged 80 years and over.

We have very few reliable data bearing on the factors which conduce to longevity.

Heredity.—Long-lived parents, particularly the mother, would seem to have long-lived children, as a rule, but we have not sufficient evidence as to the causes of early death in the parents. It may be taken for granted that, under anything like favourable conditions, good stock begets good stock.

Hardship.—We are doubtless dealing at Chelsea with the survival of the fittest. But hardship, *per se*, appears to have no deleterious effect. In fact, the medals of the older campaigns, Crimea and Mutiny, are badges of the "sturdy independent" who plays his innings to the end.

Syphilis.—Previous history is often quite unreliable, but amongst the oldest men we have found no signs of syphilitic infection.

Alcohol and Tobacco.—Apart from idiosyncrasy, we have no reason to think that either has a specific deleterious effect on the normally sound constitution. A Crimean veteran, aged 85, recently developed subacute delirium tremens on return from furlough, and made an excellent recovery.

Diet.—The old men eat enormously as a rule. Lack of teeth does not spell indigestion at the Royal Hospital. We are frequently amazed at the quantity of solid food which an old man will comfortably dispose of.

¹ Reprinted from the *Lancet*, 1922, i, 874.

UNNECESSARY INVALIDISM.

At an early stage in our service at the Royal Hospital we were impressed by, and deplored, the amount of unnecessary invalidism among in-pensioners and the even greater amount among admissions from out-pension to the Royal Hospital. Some who had had a wound, injury, or illness—often with insufficient or inefficient treatment—had lost their elementary stimuli and given themselves up to a life of invalidism, of premature and preventable decay. They had lost self-reliance, the instinct of self-preservation, and—all too often—self-respect. Such men become an intolerable nuisance in their homes, and drift into institutions as chronic “incurable” invalids. We have found that, in many cases, the physical condition as described by the patient and his friends is not supported by clinical findings, and that it is possible to do a great deal for this type of case. Much time and patience are required and it is thankless work; more often than not the patient resents curative treatment and prefers to be left to “rot” in his own way.

A pensioner, aged 41, who had been wounded in the South African War by a bullet through the frontal lobes, had been practically bedridden since 1902. He became so tyrannical in his home, and so great a nuisance to his mother, that application was made for his admission to the Royal Hospital. He was admitted in a profoundly neurasthenic state, alleging that he was practically unable to walk. After two months in the infirmary of the Royal Hospital he became physically fit to earn his own living. He deserted from Chelsea, and walked to Newbury!

DEFINITION OF OLD AGE.

It is very difficult to give a clear definition of old age. Some men are old by the time they reach 60, others are physically and mentally active at 80; old age cannot be assessed by the sum total of man's years. The Psalmist's “three score years and ten” has been too literally accepted; the “too old at forty” gospel has not helped to dispel the fallacy, and there is too great a tendency for men reaching a certain age to persuade themselves that, *ipso facto*, they have reached the last page of the book. They seem to think that they have attained an age at which a man should relinquish his activities, both physical and mental. Old age, as we see it, is not mere physical deterioration, but may be expressed by the equations: (1) Physical deterioration = senescence; (2) physical deterioration + lowered mentality = senility.

During two years 169 deaths have occurred among the in-pensioners. The average age at death was 77·2 years; the causes are tabulated at the end of this article. We have held autopsies on the majority of these cases both to check diagnosis and to satisfy ourselves that clinical treatment had been reasonably complete. Constant pathological changes have been found in the cardio-vascular system, degeneration of heart muscle and arterial

lesions, general or localized. We have particularly remarked cases of localized arterial degeneration, as some men who have exhibited "pipe-stem" radial arteries have not shown comparable arterial changes in other parts. It is easy to understand that general vascular degeneration leads to malnutrition and consequent deterioration of *all* the tissues of the body. It is equally logical that some localized lesions have their effect in determining the reactions of the body to hormonal influences. To blame any one or all of the endocrine glands as being the primary cause of old age seems to us to be placing the cart before the horse. Cardio-vascular degeneration, the failure of the mechanical factor, on which the constant strain has been exerted through life, seems, *a priori*, a sufficient and simpler explanation in the absence of direct proof to the contrary.

PSYCHIC FACTORS DETERMINING SENILITY.

Apart from the physical and mechanical side, the factors which, in our view, determine senility are the subtle, psychic changes which are evidenced by gradually lapsing sympathetic control, and the loss of balance between the sympathetic and para-sympathetic systems. Para-sympathetic activity is the first to develop, the last to lapse. It is maintenance of the equilibrium between the "vagal" and sympathetic systems which determines the normality of the adult, and our aim has been, in dealing with the problems connected with old age, to help to maintain this balance as long as the mechanical factor can reasonably fulfil its function.

Normal old age should be a physiological change of a not unpleasant nature. It is the wilful-woeful, helpless-hopeless attitude of the individual which makes old age hideous, culminating only too often in premature senile dementia. A slight accident or illness may be magnified by suggestion or auto-suggestion into being the final crisis; the patient and his friends appear to regard it as almost unseemly that he should "get better at his age!" Many old people are easily persuaded to take a morbid interest in being helpless, and soon learn to enjoy being the coddled centre of attraction, a subject for commiseration and mistaken sympathy which finally produce the self-centred abstraction so common among the aged.

Hysteria, the condition induced by suggestion, and curable by persuasion, is, we find, unexpectedly common among the old men. For an ancient watching another who cannot walk easily suggests to himself that he also cannot walk. After examining petechial patches on the dorsum of the foot of a patient, aged 83, we found, the following morning, that the old man was holding his foot in the equino-varus position, and insisting that he had lost the use of the leg. The treatment of such functional cases is simple and successful; the patient's dinner is placed at the other end of the ward, and the man can only reach it by walking

to the table. It is, of course, as necessary to eliminate any organic basis in these cases as it is important not to humour the "functional lesion." As long as a man, whatever the number of his years, responds to the "elementary stimuli"—self-reliance, the instinct of self-preservation, and self-respect—*he does not suffer from old age*. A man whose sympathetic nervous system remains tuned to the above "stimuli," is, whatever his age, not out of harmony with his surroundings. A man whose sympathetic nervous system has lost tone, or is exhausted, suffers from what we describe as "lowered mentality" in our old age equation.

Hospital surroundings undoubtedly have a tendency to induce moral and physical deterioration in the aged; do anything for an old man which he can do for himself, and he will very soon persuade himself that he can no longer do it.

DANGERS AND USES OF BED.

We have no doubt that the aged should be kept *out* of bed as far as possible. An old man, kept in bed unnecessarily, often becomes dirty in his habits, and is in danger of hypostatic pneumonia, particularly when he is the subject of lung affections, such as chronic bronchitis, emphysema, etc.

We regard it as necessary to have those acutely ill under direct medical care, as it is important to keep those not in need of nursing away from the suggestive atmosphere of hospital surroundings. Admission to hospital suggests to many of our old men that they are "on the departure platform for Brookwood Cemetery," that "it is the final canter to Woking." It lowers the morale of an old man to keep him unnecessarily in an atmosphere of helplessness and suffering. Further, the rusting mechanism of the cardio-vascular system, if left to rest too long, refuses to perform, when called upon to do so, what had been its accustomed routine. Unless there are strong indications to the contrary, such as an acute toxæmic affection, to produce a state of muscle inertia, in which the myocardium partakes, is tantamount to cutting off the vital stimuli necessary to the performance of such duties as even a degenerated heart-muscle has performed, can perform and is tuned to perform. A strong argument against keeping an old man in bed is, we find, the practical impossibility, even in an institution, of preventing "pressure sores." The skin, atrophic and malnourished arterially, has, in some cases, broken through in less than twelve hours. The buttocks, the heels, elbows, any thinly-covered bony prominence, may give way under the slightest pressure, and we have seen a case amounting to ante-mortem decomposition.

The attitude towards the patient in hospital must be cheerful and optimistic. An atmosphere of cheeriness is most important in giving confidence in his treatment and sustaining his self-confidence, thus fostering the determination in his own mind that the issue of his illness is likely to be favourable. In this regard a great responsibility rests with the visitors

who are allowed to see the patient. Commiseration and misguided sympathy may completely upset an old man's mental outlook. An injudicious visitor can, in a few minutes, stultify the medical work of days, and reduce the patient to a state of non-resistant gloom and despair. The philanthropist whose only largesse is commiseration is an unmitigated nuisance; the misapplication of so-called "sympathy" does nothing but demoralize old age. In no case have we seen a single instance where the moist eye and mournful shake of the head have helped either the patient or those responsible for his real welfare. It has been instructive to remark the dislike of sturdy independents to the attempted coddling of well-meaning visitors. To quote a Crimean veteran playing a good innings of 86: "I wish these blasted women would leave me alone."

A type of case which must be nursed in bed is the intensely toxæmic lobar pneumonia, owing to the failure which threatens the heavily poisoned and already degenerated heart. But broncho-pneumonia—so common as the flame which bursts from smouldering chronic bronchitis—is, we believe, almost inevitably fatal if the patient is kept in bed. In such cases the mechanical, rather than the toxæmic factors appear to act more powerfully, and change of position and relief of pressure are undoubtedly therapeutically necessary. The patients are less distressed when in an armchair; they sometimes ask to be allowed to sleep in an armchair, and the suggestion of being out of bed is of undoubted psychic value. The excretory functions work better; fæces and urine are more easily voided. Rest is promoted, as the inducement to sleep after getting back to bed is greater than if the patient is kept there constantly.

We are often amazed at the powers of resistance of the degenerated human machine, and at the length of time for which life can be sustained by a mechanism practically worn out, which may be coaxed to continue work, but for which no spare parts are available. When definite signs of a failing reserve are apparent we take the patient under our immediate care to help him over a threatening critical period, for it is more important in old age than during any other period of life to treat the individual and not the diagnosis. A strong indication for admission to hospital is the patient's complaint that he feels "tired," "done up," "is off his food," "has no life in him." In many such cases a day in bed, with hot-water bottles and light easily digested nutriment, suffices to tide over an impending crisis and reinforce the threatened reserve of the mechanical element in vital energy. Why a day's rest in bed should operate so powerfully in such cases, and indeed at all ages, it is difficult to explain, apart from the mechanical factor, unless perhaps the resting body is better enabled to produce the antibodies necessary to combat a new, or added infection.

LUNG LESIONS.

We have reason almost daily to remember that chronic bronchitis and broncho-pneumonia, as distinct diagnoses in the aged, are *ab initio* often

impossible to make, the one merging imperceptibly into the other. The chronic bronchitic who reports sick with even a slightly raised temperature is a patient to be regarded and treated seriously as a case of potential, if not developed, broncho-pneumonia. Apyrexia does not rule out broncho-pneumonia; we have seen a fatal case, confirmed at autopsy, where the temperature was subnormal throughout the course of the illness. It is often impossible from physical signs to discriminate accurately between the various lung lesions found in the aged; the confused medley of adventitious sounds in an old man's thorax makes it impossible to distinguish the classical signs of textbook disease. Active tuberculous lesions have not infrequently been found, post mortem, in the lungs, when the usual signs of phthisis were not demonstrable during life. As practical points in clinical treatment, we have found that the majority of so-called "bronchial asthma cases" are benefited and the spasm controlled by injections of atropine, $\frac{1}{100}$ grain, given in the early morning.

Benzyl-benzoate, in cases of the secondary arterio-sclerotic (chronic renal) type of asthma, has given most encouraging results. It also seems to relieve enteroplasm, and in two cases has been the only drug with any effect on otherwise uncontrollable hiccough of unexplained origin in men of 84 years of age.

HEART DISEASE.

In so brief a note we cannot attempt to discuss fully many common diseases in terms of old age. We have already alluded to the apparently constant degenerative changes in the myocardium seen at autopsy. In some cases the muscle wall, especially of the right ventricle, has been so thinned as to give the impression that the wall was made up of visceral pericardium and pericardial fat. Auricular fibrillation is, as might be expected, common among the aged, usually without demonstrable valvular lesion.

In our cases gross irregularity of rhythm and force of beat have been more noticeable than the usually associated rapidity of action. In an exceptional case, aged 84, irregularity was associated with a pulse-rate of 130, uncontrolled by digitalis in large doses. We have found that a formula such as the following—

R	Tinct. digitalis	..	..	(up to)	π xv
	Tinct. nucis vomica	..	..	..	π vi
	Ammon. carb.	..	..	..	gr. iii
	Aq. camphoræ	..	..	ad	$\frac{3}{4}$ i
	Quartis horis.				

gives rapid and excellent results. It is often advisable, as a measure of urgency, to initiate treatment with an injection of digitalin, $\frac{1}{100}$ grain, either subcutaneously or intravenously. As soon as the gross irregularity is controlled, the above formula, with smaller doses of tincture of digitalis, can be adopted as a routine measure to keep the heart's action at a comfortable level, the patient being seen at regular intervals after discharge from hospital.

The most distressing heart cases we have seen have been in three comparatively young men with gross aortic incompetence and cor bovinum. Until compensation failed these men did not complain, but as soon as their reserve gave way they became acutely distressed and exhibited symptoms akin to acute mania. Their discomfort, apprehension, and insomnia could only be allayed by injections of morphia, a drug which prolongs life in these cases and, what is far more important, makes continued existence tolerable. Our cases of mitral valvular disease in the aged have exhibited no features of special interest.

We have not seen a single case of true angina pectoris, but what has been described as abdominal angina is not an unusual feature in cases which reveal at autopsy advanced atheroma of the aorta and coronary arteries. The subjective signs, attributable to general arterial deterioration, are, in our experience, seldom complained of. The objective phenomena usually first bring the patient under notice. Meeting so many cases of obviously marked arteriosclerosis, we expected to find a large series of cases showing very high blood pressure, but the reverse is the actual case. The explanation is, doubtless, that the period of high pressures has been passed in middle age when a forcible heart was acting against degenerating arteries. This is the prelude to the general cardio-vascular degeneration, which we find so constantly established in old age—the era of lowered pressure of a completely faulty machine.

MALIGNANT GROWTHS.

It will be seen that malignant disease—neoplasm—has accounted for thirteen per cent of the deaths during two years. With cases of inoperable carcinoma there comes the time when the physical misery dominates the picture; we can find no excuse for withholding morphia sufficient to submerge the patient's discomfort and misery. We have heard it stated that doses of morphia sufficient to effect this purpose shorten the patient's life; we believe, however, that in many cases the comfort given and sleep gained lengthen life. Morphia undoubtedly conduces to the sufferer's comfort and confidence, and during institutional treatment it prevents the detrimental effects, on other patients, of visible suffering, and the suggestion of a painful end. Morphia is, we gather, not infrequently withheld as being the thin end of the euthanasic wedge; we wish to emphasize our view that it is inexcusable to allow unnecessary suffering when the obvious panacea is available. One learns in an institution for the aged that death is, more often than not, "*le bienvenue*," and we can find no slightest reason why its advent should be made hideous.

OTHER MORBID CONDITIONS.

Varicose Ulcers.—These heal readily in men over 80. Our general practice is to clean the surface with fomentations for two or three days, then to cover the ulcer with a slightly larger piece of thin rubber tissue,

over which is lightly bandaged a thick pad of wool saturated, and kept moist, with weak Sanitas solution. The rubber is removed every forty-eight hours, cleansed, and reapplied after the surface of the ulcer has been very lightly swabbed. The patients are not kept in bed, but are moved into armchairs during the day with stools on which the leg is rested.

Senile Gangrene.—We inspect the feet of all in-pensioners weekly, and take senile gangrene under treatment early. Destruction of tissue can usually be strictly limited by resting the limb and keeping the part dry. Three cases of moist gangrene have occurred, with fatal results, in patients whose urine contained sugar. Our weekly inspections also enable us to locate cases of early rodent ulcer, and carcinoma of superficial structures, and to offer the patient the opportunity of operation while the growth is operable—an opportunity of which he by no means always avails himself. The members of the Cancer Hospital staff have always been most kind and helpful to our old men.

Bladder.—We have been called upon to deal with surprisingly little bladder trouble. Two cases of foul chronic cystitis have been made more comfortable by regular bladder washing. Retention of urine suddenly occurring during the course of an illness is always of grave prognostic import. But men who have “reported sick” with inability to “pass their water” have usually regained the function after, in some cases, weeks of careful daily catheterization. It would seem that these cases of retention have been due to sheer atony of the bladder wall; no urethral or prostatic obstruction has impeded the passage of large metal catheters, and the function has been completely regained. A recent instance was in a Mutiny veteran aged 85.

Quack Medicines.—Many of our old men take a keen, and regrettable, interest in the advertisements of patent and proprietary medicines. The continued suggestion contained in the syllabus of symptoms has a distinctly harmful effect. An old man will produce for inspection a cutting from a newspaper which contains a list of twenty questions ranging from “Does your nose itch?” to “Do you cough on waking in the morning?” and, almost triumphantly “I’ve got *all* of them!” They are half frightened, half gratified, by pills which turn the urine green or blue: “It don’t look natural to me, but I s’pose it’s the impurities washed out o’ me system.”

Chronic Constipation.—This condition is responsible for many of the ills of old age. We have had patients whose epileptoid fits, maniacal outbursts, long-standing anorexia and generalized pains have been completely and permanently cured by regular attention to the bowels. We have observed frequently, post-mortem, the presence of stony-hard scybalous masses in the colon even in men whose “bowels are well and regularly open.” Presumably the more liquid fæcal matter forced a way past the impacted scybala. It appears that the normal expulsive reflex

of the rectum becomes dulled and finally lost in old age, the rectum and colon becoming atonic. Certainly we find that enemata are more helpful than all the usual purgatives put together. A single enema may suffice to overcome an early constipated habit. A routine dose daily of liquid paraffin and liquid extract of cascara āā ʒi. relieves many cases. The more obstinate cases require routine enemata, once or twice every week; routine enemata seem more rational than routine aperients in dealing with the obstinate constipation of old people. The atonic colon is at fault to a greater extent than the small intestine, and mechanical emptying of the rectum by means of enemata gives better results than the continual goading of the small intestine.

Ears.—Examination of the ears has revealed the fact that the majority of our old men had concretions of cerumen blocking the external meatus. Common complaints are of "feeling giddy," "singing in the ears," and "buzzing feeling in the head." Removal of the wax from the ears by syringing nearly always cures the symptoms and obviates the necessity for suspecting intracranial lesions. The deafness caused by plugs of cerumen produces a definite type of mental dullness which can be rapidly alleviated by syringing, and cured by repeating the treatment at regular intervals.

Eyes.—Eyesight means so much to the old men that the fitting of suitable spectacles is an important factor in their well-being. Complicated refractions, operative measures, &c., have been most kindly undertaken with very helpful results, by the ophthalmic surgeons of St. George's Hospital, and by the eye specialist stationed at Queen Alexandra's Military Hospital, Millbank. We have been quite unable to induce the blind men of the old army to undertake any form of distraction to occupy hands or thoughts. In this connexion we have noted particularly, that *the aged with blindness of long-standing do not drift into senile dementia*. Our observations are limited in number, but it seems reasonable that this should be so—the man has been forced to make efforts to fend for himself; his instinct of self-preservation has sharpened his other senses, and he has survived owing to the continued high tone of his sympathetic nervous system which maintains its tuned-up efficiency.

Teeth.—We do not remember having seen a single tooth in healthy condition among our old men. Those who have natural teeth are so affected with pyorrhœa that they would be a great deal better with edentulous gums. They are most averse to having teeth extracted until the latter cause pain or "become so wobbly" as to be a nuisance; a man will obstinately retain a single tooth in his head and persuade himself that it is both useful and ornamental. We do not recommend the supply of artificial teeth if the tough, hardened, edentulous gums can be made to meet in close apposition. In two and a half years we have had to recommend dentures for two men only, with limited movement of the temporo-mandibular joints which prevented closure of the edentulous jaws.

Feet.—The feet of the aged require constant care and supervision.

Corns, callosities, and neglected toe-nails are causes of discomfort and suffering amounting, in some cases, to helplessness. The appointment of a professional chiropodist, assisted by a pensioner selected from each company, has been a real boon. Light, well-fitting, and, when necessary, specially made boots are desirable for the comfort of old people. A hard, heavy, unsympathetic boot will often completely cripple an old man, even when his feet exhibit no particular deformity.

COMFORTS AND PRIVILEGES.

It is our practice to recommend the issue of flannel abdominal belts and chest protectors to old men who have been long accustomed to wear them. We do not discuss their value from a medical point of view or the real necessity for them, but we know that they make these old men happier. The garments doubtless create a feeling of warmth and comfort, and give a measure of confidence to the wearer. In-pensioners who require trusses are always specially measured and fitted, to secure comfort in wearing the truss without undue pressure on atrophic skin. In the infirmary we allow the permanent hospital patients to smoke in bed, and their desires for small luxuries are humoured as far as possible. We do not classify the routine issue of spirits as a luxury, but we use alcohol freely when medicinally necessary. Alcohol is, we believe, an essential stimulant in the treatment of broncho-pneumonia. The temporary withdrawal of small privileges is an important therapeutic agent. Incontinence with no organic basis to explain it, is cured with astonishing frequency by withholding for a day one of the minor privileges, pipe or beer. The man associates the want of his pipe with the necessity for not soiling himself.

The Commissioners of the Royal Hospital arrange for weekly drives in motor charabancs for the infirmary patients, and the change does much to prevent the self-centred abstraction so common among the aged. We often find that a change of ward, involving new surroundings and new companionship, has a similar beneficial effect.

DIAGNOSIS.

A brief reference should be made to the difficulties that may arise in connexion with the protean manifestations of uræmia in the aged. Another condition which must be remembered is myxœdema; a man, aged 74, whose general condition suggested chronic parenchymatous nephritis, has been almost rejuvenated by the administration of thyroid. In this connexion we have noted two cases of acute general eczematous dermatitis which have cleared up under small doses of thyroid extract. The occurrence of thyroid insufficiency does not appear to be particularly frequent in the old; at any rate, we see no reason to believe that hypothyroidism is the cause of old age, or that the administration of thyroid extract is the panacea that some writers rather enthusiastically suggest.

SUMMARY AND CONCLUSION.

There are few conditions more difficult to define than old age. The term "senescence," implying physical deterioration only, conveys to us the meaning of physiological and normal old age, a condition but little complicated by social or medical problems. We use the term "senility" for morbid old age—the condition, a burden to the individual and his friends, which is evidenced by physical deterioration plus lowered mentality.

The problems connected with old age are chiefly due to this lowered mentality of the senile. The independent individual, whatever his age, is not out of harmony with his surroundings. It is the man who has lost his elementary stimuli—self-reliance, the instinct of self-preservation, and self-respect—who creates a social discord. These stimuli are often allowed to lapse prematurely and without adequate cause, with the result that much unnecessary invalidism burdens the patients' homes and the State. We interpret the "lowered mentality" in our senility equation in terms of loss of balance between the sympathetic and the para-sympathetic nervous system. Subtle psychic changes and lapse of sympathetic control, in our view, go hand in hand and finally culminate in senile dementia. Hysteria is unexpectedly common among the aged. Auto-suggestion and pessimistic hetero-suggestion have a most demoralizing effect upon the senescent. The senescent should be kept away from the suggestive atmosphere of hospital surroundings, unless they suffer from conditions which call for nursing and constant medical supervision. Old men should not be nursed in the same ward with considerably younger men, suffering from hemiplegia, advanced tabes, etc. Suicide is apt to be infectious in an institution for the aged, and men who attempt suicide should be transferred to an institution where the care of mental cases is undertaken.

The attitude of all concerned with the treatment of the senescent in hospital should be one of cheery optimism. A Mutiny veteran, aged 89, with broncho-pneumonia, who stated on admission: "This time I'm booked for the Other World," was much amused when told that "the return half of his ticket was sticking out of his pocket," and made an excellent recovery. Badinage, and cheery chaff, if unofficial tonics, are wonderfully effective. Cases of broncho-pneumonia in the aged, if kept in bed, are—we believe—almost invariably fatal. An old man can very seldom be kept *comfortably* propped up in bed. We have had startling recoveries in men who have been put into armchairs every day; as a further instance of suggestion, we find that the patient's trousers are of the greatest therapeutic value; he regards his own condition far less seriously when he is clothed than when he is swathed in blankets. We urge the value of encouraging the "will to live" when the senescents are curable patients in hospital, but we strongly advocate the use of morphia when discomfort and pain become the dominating features in incurable diseases.

TABLE OF DEATHS.

During the two years, August 1, 1919, to July 31, 1921, there were 169 deaths among the in-pensioners. The average age at death was 77·2 years. The cause of death in the attached table is shown under the outstanding clinical and post-mortem findings, but in the majority of cases more than one system (circulatory, respiratory, excretory, etc.) had degenerated or was actively diseased.

Cause of death	Number	Percentage of total
Circulatory system (including cerebral hæmorrhage, 4; arterio-sclerosis; aneurysm; V.D.H.; myocardial degeneration; suppurative myocarditis with rupture into pericardium, 1)	64	.. 38
Respiratory system (pneumonia, broncho-pneumonia)	41	.. 23
Renal disease (uræmia, &c.)	12	.. 7
Malignant disease	22	.. 13
Senile gangrene (associated with glycosuria, 3)	4	.. —
Chronic pachymeningitis (senile dementia, tabes, 1)	11	.. 7
Accidents (knocked down in street, etc.)	4	.. —
Septicæmia	1	.. —
Tuberculous disease (lungs, 2; larynx, 1)	3	.. —
Cirrhosis of liver	1	.. —
Suicide (by hanging)	1	.. —
Post-operation (shock and pneumonia)	1	.. —
Gastric ulcer (with hæmorrhage, patient aged 71)	1	.. —
Chronic pancreatitis (with cholangitis)	1	.. —
Result of old wound	2	.. —
Total	169	

Of the 22 "malignant diseases," the primary sites were as follows: Side of head, 1; tongue, 2; floor of mouth, 1; rodent ulcer (septic pneumonia), 1; pancreas, 2; gall-bladder and ducts, 5; stomach, 2; pylorus, 2; colon, 5. One case with carcinoma of descending colon died of general peritonitis due to rupture of stercoral ulcer in cæcum.

THE MEDICAL ASPECT OF AN EIGHTEENTH CENTURY BATTALION.

By CAPTAIN J. F. BOURKE, M.C.
Royal Army Medical Corps.

I.—INTRODUCTORY.

AN accurate idea of the intimacies of a period can be obtained more often from the diaries, letters, directions, and the like, written and meant for the daily life of the times than from historical tomes or set pieces of description consciously intended for the sake of posterity rather than for the living generation.

In the course of some desultory browsing among eighteenth century military works, I happened across a book which gave so intimate a picture of the daily life of an infantry battalion that it seemed worth while abstracting the portions relating to the medical aspect for publication in the JOURNAL. As the work does not appear to be quoted in the usual medical military histories some good may result if the attention of the serious historian is called to it.

The author was "Bennett Cuthbertson, Esq., Captain in His Majesty's Fifth Regiment of Foot, and late Adjutant to the Same." He published his work in 1768, after having served for the long period of twelve years as an adjutant. The book was in part, at least, ordered in advance of publication by means of the subscriptions of his brother officers in various regiments, which tends to show that the opinions of the author were then held in some esteem by a number of officers serving at the time. The book is entitled "A System for the Compleat Management and Oeconomy of a Battalion of Infantry." The date of publication, 1768, was during the lull of peace between the conclusion of the Seven Years' War, 1763, and the American War of Independence, with the consequent rupture of peace with France in 1778.

The period was before the reforms of the medical services which the war time years of 1793 and 1796 made essential. The duties of the supply of medicines were still individualistic, vested in the regimental surgeon, and not yet taken over by the Apothecary General. The surgeon still had his surgeon's "mate" who had not yet become the assistant surgeon (Royal Warrant of November 30, 1796), and the status of neither had as yet been accurately defined, as in 1796, when for allotment of quarters and other advantages the surgeon ranked as a captain and the assistant surgeon as a subaltern.

The author like all true reformers was in advance of his age, but he makes it quite plain that the system he advocates was in operation in a

number of well-ordered battalions and was considered by him the best suited for the requirements of his times. This point is emphasized, as I want to make it clear, that, although the author has written his work in the form of a series of recommendations, they actually depict the best of the daily military routine then existing.

In his prefatory remarks he outlines in language which to our ideas may seem quaint, the scope of his work. "Although the whim and caprice of some Commanding Officers, may render it extremely difficult, to adhere to any system for interior Oeconomy and Order, yet most of the Articles in the following Chapters, will be found agreeable to the Practice of several excellent Battalions, from whom they were carefully collected and adopted with success by that, to which I had the Honour of being Adjutant, their Use, I flatter myself, will be to show young Officers in general by what easy methods, Regularity may be established in a Company or Battalion, and that they may in a particular manner be useful to those, whose Connections hurry them into Rank, before they are qualified, by Application, to discharge the several Duties of it with honour, even to themselves, much less with Advantage to the Corps entrusted to their Care."

II.—THE REGIMENTAL HOSPITAL.

The chapter headed "Of the Treatment of the Sick and the Management of the Regimental Hospital," gives a full account of the difficulties that existed and the means taken to overcome them. The chapter opens with some general remarks on "Humanity" and then settles down to deal with the minutiae of the problem.

"Officers have it greatly in their power to exert humanity, in the case of the Soldiers, when labouring under the distress of Sickness, by contriving every convenience and ease for their relief, and by insisting on the punctual observance of whatever is established for that purpose; this part of an Officer's Duty must surely be very pleasing, since without his Attention many deserving Men will inevitably be lost."

Directions are given that as soon as a "Regiment marches into Cantonments or Camp" a house should be hired for use as a Regimental hospital, or a number of rooms, specially selected for the purpose, should be set aside in Barracks. "An experienced, careful Woman must be constantly employed to attend in the Regimental hospital, as a Nurse, whose wages should be paid by the Surgeon, when he has an Allowance for it, or from the savings of the Sick Men's Pay. An Orderly or more, if necessary, should be appointed daily from the Companies in turn to assist in the attendance of the Sick. A Serjeant or Corporal should be appointed to regulate the Oeconomy of the Hospital, and to preserve order and cleanliness in it, he must receive the Sick Men's Pay, keep the accounts, buy provisions, and follow such directions, as he may from time to time receive from the Surgeon."

In Ireland the Barrack Board provided not only the hospital building itself, but also the equipment. In England the provision of "a proper number of blankets, sheets, and canvas cases (to be stuffed occasionally with straw for beds and bolsters), with other necessary utensils," had to be found out of the regimental non-effective fund. On the line of march the equipment was divided among "the waggons of those Companies, where the Hospital is to be established, unless particular carriages are allowed for the Sick."

Rations, at that period, for the whole battalion were purchased regimentally from the stoppages made from the pay of the soldiers for that purpose, and the same system was recommended for the diets of the sick in the regimental hospital. The author continues: "The subsistence of the men in Hospital must be thrown into a fund for the benefit of the whole, in general, and no particular account given to each man, in what manner his money may have been expended; for though the disorder of one may not require the consumption of his pay, yet that of another may much more, when wine, rich broths, and things of that kind are absolutely necessary; the Non-commission-officer should keep this account in the exactest manner, as it ought to be inspected every week by the Surgeon and once a month by the Paymaster of the Regiment; and should any over-plus then remain, it is to be established into a fund for the advantage and improvement of the Hospital." "The subsistence of the Private-men is all that need be paid into Hospital, on any occasion, if it be under proper regulations . . . for their support while under the Surgeon's care—many not being allowed more to live on, when in stoppages for necessities, although in perfect health; nor should the Serjeants, Corporals, or Drummers contribute more than the Private-men, as their treatment in Hospital can be but pretty near the same."

The "Non-commission-officer" doing duty at the hospital besides general superintendence and stewards' functions was also responsible for the work which nowadays falls on the pack, linen, and clothing stores; for the author says: "A particular part of the Hospital should be allotted for the use of the Non-commission-officer attending there, in which he is to keep the Sick Men's knapsacks, in regular order; it being his business to deliver out clean linen when demanded, and also to receive the dirty, which he must give to, and receive from the wash, paying for it from the general fund of subsistence; and if the arms and accoutrements are in his care, he is to keep them in the same place, carefully hung up."

The author, after pointing out that the surgeon should visit the sick in hospital at least twice a day, proceeds to deal with the potential evil of hospitalization. He remarks that "Soldiers should never be sent to an Hospital for trifles, nor detained in it longer than is absolutely necessary for their cure, as they are apt to contract a habit of idleness and a dislike for returning to their Duty; at the same time, care must be taken that they are not dismissed too soon, lest cold, or improper diet might occasion a relapse."

III.—GENERAL MEDICAL ARRANGEMENTS.

The morning sick who were suffering from minor disabilities were treated at the hospital by the surgeon as on the ordinary sick parade at present; but there appeared to be a large number reporting sick in quarters. The system of the "Serjeants and Corporals" at morning roll call giving "a return to the Orderly Corporal of the names of the Sick in their respective Squads, mentioning the street and sign where each man is quartered, or the number of his Barrack-room or Tent, from which he is to make out a general one of the Company and lose no time in delivering it to the Surgeon" was much the same in 1768 as it is in 1922. A special warning is given that "Men must be strictly forbid not to tamper with themselves, nor to apply for Medicines to any person except the Surgeon of the Regiment, or those appointed to take care of the sick—the sort of quacks that Soldiers in such cases generally address themselves to, are much to be dreaded."

Detailed instructions are given to cover the case of the soldier who becomes acutely ill on the line of march, and is not "able to proceed further (even on a carriage) without imminent danger, . . . must be left in his billet, and to prevent the landlord's being troublesome, after the Company is marched from the town, an application should be made to the Civil Magistrate to confirm his continuance at the house, as long as may be necessary; a careful, sober, Private-man must also be left to take care of him, with sufficient subsistence for both; and if there be any Troops quartered in the Town, an address should be made to their Surgeon to attend him, otherwise some proper person must be employed."

The special precautions to be observed in handing over patients to the "Hospital of the Army" on active service are also recounted. "When a Regiment is on service and it is requisite to send the Sick to the Hospital of the Army . . . an escort should always be sent to attend them on the road when going there, and a Non-commission-officer to deliver up their Arms, Accoutrements, and Necessaries to the Store-keeper, from whom a receipt ought to be taken for every article, and likewise for the subsistence paid in with each man, which receipt the Non-commission-officer, on his return to the Regiment, must deliver to the Paymaster, that it may be held as a proof against the Managers of the Hospital should any embezzlement or unjust charges afterwards appear; a mate must also be sent (if possible) to take care of them on the journey and to represent their several cases to the Physicians or Surgeons of the Hospital; but if one can not conveniently be spared from the immediate service of the Regiment, an exact state of them should be drawn up by the Surgeon to be delivered to the Non-commission-officer."

The problem of the soldier who has become disabled in the Service is dealt with on very sound lines, and directions are given for the type of men who should be discharged for physical defects or disease.

"And as the humanity of Government has made a provision for Soldiers

who are worn out or disabled in the Service, there can scarcely be a pretence, for detaining such Men in the Regiment, as they may be recommended to the Invalids, and by that means quietly enjoy repose the remainder of their lives, instead of being exposed to those fatigues, which every Corps is subject to, and without being able to afford the least advantage to the Service, to which they are rather an incumbrance."

"A man troubled with fits, a rupture, inveterate ulcerated legs, or any material defect in his limbs, by wounds or otherwise, can never be allowed capable of performing the Duty of a Soldier, therefore when all methods have been in vain tried to conquer such complaints, and the proper judges have declared him incurable, and no imposition is to be suspected, he ought to be discharged the first convenient opportunity."

IV.—RECRUITING.

Recruiting for the regimental officer appears to have been an arduous and unpleasant duty not unattended with the risk of financial loss. The chapter on this subject commences, "As recruiting is a Duty attended with many disagreeable circumstances to the Officers employed on it, and very often the cause of their total ruin, it is in a particular manner incumbent on the Commander of a Regiment, to avoid, if possible, the sending out such Gentlemen, whose inexperience in the Service, and whose turn to extravagance, give the strongest reason to suppose them unqualified for such an undertaking . . ."

The Surgeon did not normally accompany the recruiting party, but was responsible, at least, financially, for dealing with sickness among the personnel, as the author states: "He must also be answerable if a Serjeant, Corporal, Drummer, etc., is sick when recruiting . . . that the person who attended him is properly satisfied; this is but reasonable, as he receives a constant weekly allowance from the Non-commission-officers and Soldiers to furnish medicines."

The initial medical examination fell to the lot of the supervising regimental officer in charge of the party. He is warned that "In-kneed, or splay-footed Men should never be enlisted, being from the formation of their limbs, unable to undergo the fatigue of tedious Marches; those with round shoulders, or past thirty years of age, are also to be avoided, the first never acquiring an upright carriage, and the others from the stiffness of their joints, seldom learning to handle their Arms with dexterity."

"Men with ruptures, scald heads, convulsion fits, or other extraordinary complaints, ought on no account to be received, and very rarely one discharged for a lameness, or particular infirmity, from another Regiment, though at the time he offers he may, to all appearance, seem perfectly cured, as it is odds, when he again becomes tired of the Service, he will feign the return of his old complaint, in order to deceive, and thereby hope to obtain his discharge."

"Young, active men, from seventeen to twenty-five years of age, make

the most tractable Soldiers; nor should they be desired taller than six feet, nor lower than five feet six inches and a half, when circumstances will admit so great a nicety. . . . Great attention must be paid to the faces, legs and shoulders of recruits, and that lads under eighteen have stout thick joints (a certain indication of growth) and not too much the look of being set; fine hair is also to be desired, it being so great an addition to the appearance of the Soldier."

It is pointed out that "Sailors and Colliers never make good Soldiers being accustomed to a more debauched and drunken way of life, than what a private Sentinels Pay can possibly admit of; and soon become disgusted with the Service, from which they speedily desert."

V.—MALINGERING AND VENEREAL DISEASE.

The author refers to malingering in brief terms, and recites the case of a soldier who successfully obtained his discharge by feigning "a paralytick shake of the Head" for the long space of twelve months.

"Although the greatest care and tenderness should be shown to Soldiers, when in reality afflicted by any kind of disorder, yet every method must be used, to detect their pretending sickness, merely for the sake of avoiding extra-ordinary Duty or Exercise, nay, sometimes from a design of obtaining a discharge; when such villainous impositions are, therefore, at any time discovered, no mercy should be shown to the offenders in the punishment allotted for it."

The author had evidently given careful thought to the venereal question, as far as it affected a battalion, and sums up his views in the following paragraph:—

"In Regiments where venereal complaints are cured gratis, the number of Men with that disorder are considerable, nothing being more frequently suspected, than that many soldiers endeavour to contract it in order to avoid Exercise or Duty, if either happens to be more frequent than they desire; a certain proof of their having designedly done so, they well know, is not easily to be obtained, therefore they are under no apprehension of the smallest punishment, but instead of it, are gratified with some weeks of idleness in Hospital where they are cured, without any more additional expence than if their disorder had been of another nature; the hardships thrown by these idlers on the temperate, sober Soldier, who by their irregularities is obliged to do extra-ordinary Duty, is very shameful, and should be as much as possible discouraged; on the contrary, it is a known fact, that those Regiments which inflict a pecuniary punishment on every Drummer and Private-man cured of such a disease, have not by half so many distempered Men . . . and in order to deter them from concealing it (the only objection started against this custom) the fine should be doubled, if by neglecting to consult the Surgeon in proper time the disease becomes a pox; this money to be stopped from their pay as soon as the Surgeon

declares them to be perfectly cured, and thrown into the Fund established for the Regimental Hospital."

VI.—PROPHYLAXIS AND SANITATION.

On the hygienic and prophylactic side it will be seen that great attention was paid to the health of the soldiers, as far as the knowledge of the age allowed, and that military sanitation was by no means so neglected as many modern sanitarians imply when referring in tones of contempt to bygone times.

Neither the surgeon nor his mate appeared to have been regarded as having any special duties in this connexion. Curative and preventive medicine were divorced. It is instructive to note in the Standing Orders of an infantry battalion published some twenty-five years after this book was printed, that the surgeon is distinctly reminded that "It is expected that the Surgeon will communicate to the Commanding Officer every circumstance which may strike him as being detrimental to the general health of the Soldiers, or which he may think will be beneficial to it."

There is a chapter devoted to messing, from which I will merely quote sufficient to give an idea of what was considered an adequate ration at the time, and the normal constituents of it.

"Three quarters of a pound of meat, and one pennyworth of bread, with a proportion of roots, etc., for making broth, should at least be the calculation for each man's mess for a day; but when the cheapness of provisions will admit of it, the allowance of meat ought to be augmented to one pound, as the less money a Soldier has to spend on drink, the better will be his health, his attendance to duty more punctual, and his dress more becoming."

The married soldier is specially considered in a separate paragraph.

"Those Soldiers who are married to industrious, sober women, that can earn near as much as their husbands' pay, and can be depended on for eating well, may be excused from messing with their Companies; but if on the contrary the wives are idle, and trust to them for support, it must be insisted on that such men be appointed to a mess, to prevent their being starved."

The messing of the soldiers on long sea voyages is carefully considered, and directions are given for preserving the best keeping vegetables. Tobacco is regarded as having anti-scorbutic qualities, as it is stated that "a supply of tobacco will also be necessary, it being a preservative against the scurvy in the gums."

"Inoculation" was fully appreciated as a preventive for those soldiers who have not already had smallpox, who are "subject to many distresses, by constant apprehensions, and the chance of taking it on a March"; and the author says it should be "strongly recommended to them to undergo inoculation, as a certain means of saving many lives; it being well known

that the unprepared state in which that distemper generally finds a Soldier's blood, renders the taking of it in a natural way, too often attended with very fatal consequences, even though circumstances admit their being treated with the utmost tenderness."

Minute directions are given for the cleanliness of quarters, both in barracks and in camp, and also on board ship. "The Serjeants and Corporals are to insist on the Men sweeping out their rooms, making and turning up their beds, and putting all the utensils given for their use, in proper order, every morning before they attend Roll calling . . . and that cleanliness and neatness appears in every place where the soldiers are concerned, as nothing will contribute more to the preservation of their health."

"When a Regiment is likely to remain above a night upon the same encampment, the Soldiers should be obliged to cut small trenches round their tents, to carry off the rain, which otherwise must run among the straw; and as a preservative to their health, and to prevent the increase of vermin, the blankets allowed them by His Majesty should be well shaken and hung out every fair day; and it will contribute much to those two ends, to strike the tents about two hours at noon in order to air the straw which, by neglect of this precaution, imbibes a dampness from the earth, which often proves destructive to the Soldiers, and fills the Hospitals of an Army."

The additional precautions recommended on board a "Transport ship" are the sprinkling of the berths with vinegar, after sweeping, and the frequent burning of a "pitch-pot" between decks.

Regular health inspections as practised at present were unknown. The duty of supervising the personal hygiene of the Soldiers was left to the "Serjeants and Corporals." The Company Orderly Corporal apparently took a consolidated return from the squads as among his duties it is noted he should "collect the names of such Men as have got the Itch, and insert them in his report, that the Surgeon may take the speediest method of curing that filthy disease, and prevent its spreading through the Regiment."

The necessity of dealing with the bedding of scabetic patients is plainly and bluntly stated. "The Non-commission-officers are to be particularly attentive to those Men, who are under cure for the Itch, that their sheets and bed cloaths, with whatever else may retain infection be properly washed and aired after it; without this precaution is strictly observed, the medicines will be useless." Salutory directions are also given to ensure that when a patient is dismissed from Hospital, the straw filling of his bed should be burnt, and his blankets properly washed before re-issue.

VII.—MISCELLANEOUS.

In concluding, I feel tempted to abandon the medical aspect to quote from the chapter "Of Servants and Batmen, with some necessary Rules relative to Them," as the author has so many shrewd observations to make that are as true now as when he made them over a hundred and fifty years ago.

A clear distinction is made between servants and batmen following the proper etymological derivation which our modern War Establishment tables have obscured. The batman is, strictly speaking, the pack or bathorse leader or driver. Webster's Dictionary has the following definition: "[French, *bât*, a pack saddle] . . . a person having charge of a bathorse and his load." The word is used in this sense by Macaulay.

On the subject of payments the author remarks, "The wages given to Servants and Batmen should be the same from the Colonel to the Subaltern . . . by which means the discontent and insolence that are often experienced in those who perhaps may have smaller wages than others, might in a great measure be restrained, and the Ensign served with as great attention as the Field Officer."

"It ought to be a fixed Rule, that when a Servant or Batman quits the service of an Officer for misbehaviour, no other Officer should ever take him, and lest such an event might in the course of years be subject to oblivion . . . it should be marked down in a registry to be kept for that purpose."

The general deterioration which is still to be noted when an officer's servant is away from regimental duty for too long, is observed and guarded against, the author remarking that "Servants should never be excused from Exercise or weekly review of Arms and necessities, that they may not intirely forget their Duty in the Ranks, and to remind them of their being Soldiers . . . and prevent their contracting many saucy habits, which might otherwise be the case."

Batmen, being occupied with the care of their horses, were excused attendance at the company parades.

Clinical and other Notes.

REPORT ON AN EPIDEMIC OF JAUNDICE AT PORT SUDAN.

BY CAPTAIN W. T. WHITEHEAD,
Royal Army Medical Corps.

SOME forty-seven cases of jaundice, associated with fever, occurred in Port Sudan between the beginning of January, 1922, and the end of March the same year.

Distribution.—All the cases originated in Port Sudan with one exception. This case left Port Sudan two months before developing an attack of jaundice.

Endemiology and Epidemiology.—For the last sixteen years there is no record of there having been any jaundice cases of this nature in Port Sudan.

The possibility of man acting as the direct carrier is unlikely. No case occurred in the hospital where a number of the jaundice patients were treated in the ordinary wards; and, where the disease occurred amongst a collection of men sleeping and living in close proximity, only a very small proportion of the whole contracted the disease, nor did these come into closer contact with the other sick men than with the healthy ones.

Rats are possible carriers of the virus, as also are flies, of which there were large numbers.

Approximately equal numbers of patients came from the small villages round the town, and from the town itself.

The villages consist of small grass huts, which are somewhat congested, and good sanitation is almost impossible to obtain, whilst the town houses are mostly built of brick with plenty of air space, and with the usual sanitary conveniences.

It must, however, be noted that a proportion of the inhabitants of the town houses eat all their meals in the market place, which possesses the same facilities for harbouring rats and flies as the villages outside, so that the town man stands as good a chance of eating contaminated food as the man living in the villages.

There were practically no mosquitoes in Port Sudan during this time of year.

Aetiology.—Males of between 20 to 30 years of age, and belonging to the Dongaloui tribe, were the most prone to infection.

There were no cases amongst women, and only one child was affected.

No Europeans contracted the disease.

Pathology.—Facilities for carrying out pathological examinations were only available at the end of the epidemic. Eight cases were so examined, two of these being quite recently infected patients, whilst the remaining six had had the disease for varying periods.

The histories and clinical notes of all the forty-seven cases so closely resembled one another that it seemed justifiable to regard the findings in the eight cases examined in detail, as indicative of what one might expect in the remaining thirty-nine cases.

The primary lesion appeared to be either in the stomach or the proximal end

of the duodenum giving rise, as it invariably did, to pain in the epigastrium, and very frequently to vomiting.

The liver was not, as a rule, enlarged.

The conjunctivæ were yellow in the recent cases.

There was no rash, and the skin appeared normal.

The blood showed marked leucopænia, averaging about 3,000 white cells per cubic millimetre, with a relative increase of lymphocytes, which averaged forty per cent. The number of red cells and percentage of hæmoglobin was normal. No parasites were found in the blood. No organism was cultivated from the blood. The serum did not agglutinate *B. typhosus*, *B. paratyphosus* A or B.

The stools of the recent cases had the usual clay-coloured appearance associated with jaundice.

No organism of the enterica group was isolated from the stools.

There was no diarrhœa.

The urine of recent cases contained bile. There was no albumin.

The urine of almost all the earlier cases was examined for albumin, and its absence was noted in every case.

Spirochætes were present in considerable numbers in the urine of two of the cases, and were of a coarse variety.

Animal Experiments.—Guinea-pigs were inoculated intraperitoneally with the urine of certain cases, all remained fit for eight and a half weeks, when the animals were killed, and the organs, blood and urine were examined. Nothing abnormal was found post mortem in these animals.

Sections were cut of the kidneys, livers and spleens of these animals, and no spirochætes were found microscopically.

Symptomatology.—The chief symptoms were: Jaundice, headache, pain in the epigastrium, a furred tongue, slight fever for one or two days, and vomiting after food. The pulse rate was normal.

The majority of those cases admitted to hospital showed no rise of temperature after admission, and in no case did the temperature rise above 100° F., or last more than three or four days. The average stay in hospital was four days, the jaundice disappearing five or six days after the date of onset, and none of the cases seem to have suffered from weakness or debility after their discharge from hospital. No complications were noted.

Three of the cases had a second attack some weeks after the first attack, so presumably the immunizing properties of the causal agent are slight.

Diagnosis.—These cases were diagnosed jaundice, camp jaundice being differentiated from spirochætosis icterohæmorrhagica on account of the mildness of the attack, the absence of rapid enlargement of the liver, the absence of albuminuria, the immunity of guinea-pigs to the disease, and to the absence of hæmorrhagic symptoms.

The differentiation from yellow fever was made because of the absence of high fever, albuminuria and the black stools, and vomit usually associated with that disease. Added to these points, no *Stegomyia fasciata* have been seen in the place.

Prognosis.—No serious case of illness occurred amongst the forty-seven patients treated.

DETAILED NOTES OF EIGHT CASES.

	Symptoms							Physical signs		Day of disease	Blood examination						Urine				Feces	Remarks							
	Jaundice	Epigastric pain	Fever	Vomiting	Diarrhoea	Headache	Dizziness	Enlarged liver	Enlarged spleen		Agglutination of Bac. T. : Para A and B	Broth cultures	Animal inoculation	Red count	White count	Differential count	Albumin	Broth culture	Spirochaetes	Animal inoculation									
1	+	+	+	—	—	+	—	—	—	—	—	—	N	2,500	P : 40 M : 4 L : 50 E : 5 B : 1	—	—	—	—	—	—	—	—	—	—	—	—	—	Leucopenia, lymphocytosis, animal inoculation, — or
2	+	—	—	—	—	—	+	—	—	—	—	0	7 million	8,343	P : 53 M : 9 L : 93 E : 4 B : 1	—	—	—	+	—	—	—	—	—	—	—	—	—	Leucopenia, spirochaetes in urine ; animal inoculation — or
3	+	+	+	—	—	+	—	—	—	—	0	0	0	4,760	P : 32 M : 7 L : 47 E : 12 B : 2	—	0	0	—	0	—	—	—	—	0	—	0	—	Patient quite fit (10th day) : leucopenia, lymphocytosis

4	+	+	+	+	+	+	+	+	+	14th	-	-	0	0	0	5,000	$\left. \begin{array}{l} P : 19 \\ M : 7 \\ L : 70 \\ E : 2 \\ B : 2 \end{array} \right\}$	-	0	-	-	-	-	-	-	-	Patient fit (14th day), leucopenia, lympho- cytosis
5	+	+	+	+	+	+	+	+	+	17th	+	+	0	0	0	3,000	$\left. \begin{array}{l} P : 44 \\ M : 6 \\ L : 38 \\ E : 8 \\ B : 4 \end{array} \right\}$	-	-	-	-	-	-	-	-	-	Patient unfit (17th day), still weak ; leucopenia
6	+	+	+	+	+	-	-	-	-	17th	-	-	0	0	0	8,000	$\left. \begin{array}{l} P : 60 \\ M : 2 \\ L : 33 \\ E : 5 \\ O : 0 \end{array} \right\}$	-	+	-	-	-	-	-	+	0	Patient fit (17th day), spirochaetes in urine
7	+	+	+	+	+	+	+	+	+	20th	-	+	0	0	0	4,700	$\left. \begin{array}{l} P : 30 \\ M : 2 \\ L : 48 \\ E : 20 \\ B : 0 \end{array} \right\}$	-	-	-	-	-	-	-	-	-	Patient fit, eosino- philia, leucopenia, lymphocytosis
8	+	+	+	-	-	+	+	+	-	24th	-	-	0	0	0	0	$\left. \begin{array}{l} P : 5 \\ M : 0 \\ L : 27 \\ E : 66 \\ B : 2 \end{array} \right\}$	-	0	0	-	-	-	0	-	0	Patient fit ; eosino- philia

+ = Present or positive result.

- = Absent or negative result

0 = Not tested.

Treatment consisted in the administration of aperients combined with light dietary.

My thanks are due to Dr. Noel Waterfield, S.M.O., Red Sea Province, for his great help in putting all available material at my disposal, and for supplying me with clinical notes on all those cases that it was impossible for me to examine myself.

NOTES ON A CASE TREATED BY INTRAVENOUS INJECTIONS OF TARTAR EMETIC.

BY MAJOR B. H. V. DUNBAR, D.S.O.

Royal Army Medical Corps.

W. R. H., garrison engineer, Zhob area, aged 29, was transferred to the British Station Hospital, Quetta, on December 3, 1921. He had been in India eight years, and stationed in the Zhob Valley since August, 1921. He was in Peshawar for three years before that and also in Delhi and Simla, but had never been to Assam. He gave a history of malaria, but stated he had not had an attack for the past six years. He went into hospital on November 14, 1921, with fever (irregular temperature) which he stated was the commencement of the present illness.

On admission he was very markedly anæmic, the skin being of a peculiar "earthy grey" colour. He was very emaciated, his arms and legs being "stick like," but his abdomen was very protuberant. The marked fullness of the abdomen was due to an enormously enlarged spleen which was soft on palpation and reached vertically well below the level of the umbilicus, and nearly into the left iliac fossa and beyond the middle line to the right. The spleen dullness merged into that of the liver which was also enlarged upwards and downwards, the lower border being felt two to three fingers' breadth below the costal margin. The heart was generally enlarged, apex beat one inch external to and below the nipple. There was a harsh blowing murmur loudest in the pulmonary area and down the left side of the sternum, but heard also at and external to the apex beat. The second sound in the pulmonary area was loud, but blurred.

The lungs were quite normal.

His temperature all through was of an irregular type, and there was always a rise some time during the twenty-four hours.

No malarial parasites or Leishman-Donovan bodies were found in the peripheral blood, but the blood serum gave a positive reaction for kala-azar with formal-gel test.

The blood count was as under: Total white blood-cells 1,000 per cubic millimetre. Differential count: polymorphonuclears, 48 per cent; lymphocytes 32 per cent; large mononuclears, 16 per cent; eosinophiles, 4 per cent.

There were a few nucleated red blood-cells and very slight poikilocytosis.

The coagulability of the blood was diminished and the hæmoglobin was greatly reduced; this was quite noticeable to the naked eye.

From the time he came under observation in November, 1921, till he was transferred to this hospital he was treated with arsenic and quinine, the latter given intravenously as well as by the mouth. This treatment was continued for

some days after his arrival here but it made no difference to his temperature, splenic enlargement or his condition generally, in fact he was gradually getting worse, and not much hope was entertained of his ultimate recovery.

Owing to the state of the blood and this patient's serious condition, it was not considered advisable to do a splenic or liver puncture to arrive at a definite diagnosis, though his general condition, enlarged spleen, serum reaction and blood picture were highly suggestive of kala-azar. It was therefore decided to start treatment with tartar emetic given intravenously. A two per cent solution prepared fresh every time was used throughout the whole course of treatment. One was struck by the absence of practically any reaction or toxic symptoms after the injections and by the very marked improvement in the patient's general condition.

The following is the subsequent course, progress and treatment of the case:—

December 15, 1921.—Intravenous injection, three cubic centimetres of two per cent solution tartar emetic. No reaction.

December 16, 1921.—No apparent change in patient's condition. But he said he felt better. Temperature normal for the first time.

December 17.—He seemed a little better and was much brighter. Intravenous injection four cubic centimetres of two per cent solution tartar emetic. No reaction.

December 18.—Patient's condition improved. Spleen appeared to be diminished a little in size, especially inner border which did not quite reach the middle line.

December 19.—Intravenous injection five cubic centimetres of two per cent solution tartar emetic. No reaction.

December 22.—Improvement maintained. Intravenous injection five cubic centimetres of two per cent solution tartar emetic. No reaction.

December 24.—Liver dullness decreased. Lower border not felt below costal margin. Spleen also reduced in size. Inner border well away from middle line, and lower border about three fingers' breadth below costal margin. Patient did not look quite so anæmic.

December 26.—Intravenous injection five cubic centimetres of two per cent solution tartar emetic. No reaction except a slight tickling at the back of the throat and irritable cough lasting about five minutes. This followed immediately after the injection and was present at every subsequent injection.

December 27.—There was such a decided improvement that patient was allowed out of bed for the first time. He is putting on weight.

December 29.—Intravenous injection five cubic centimetres of two per cent solution tartar emetic. No reaction.

January 2, 1922.—Intravenous injection six cubic centimetres of two per cent solution tartar emetic. Slight reaction. Mild rigor, temperature 99.8° F. Feeling of nausea but no vomiting. These symptoms very soon passed away.

January 5.—Improvement still more marked. Patient much stronger. Intravenous injection six cubic centimetres of two per cent solution tartar emetic. No reaction.

January 9.—Intravenous injection six cubic centimetres of two per cent solution tartar emetic. No reaction. Blood count again taken, result as follows: total red blood-cells, 2,256,250 per cubic millimetre. Total white blood-cells,

4,812 per cubic millimetre. Differential count: polymorphonuclears, 62 per cent; large mononuclears, 13 per cent; lymphocytes, 25 per cent; eosinophils, nil.

January 14.—Intravenous injection 6·5 cubic centimetres of two per cent solution tartar emetic. No reaction.

January 18.—Intravenous injection seven cubic centimetres of two per cent solution tartar emetic. No reaction. Brought before a medical board and recommended for six months' leave to England.

January 24.—Intravenous injection seven cubic centimetres of two per cent solution tartar emetic. No reaction.

January 25.—Patient now convalescent. He was up and about, eating and sleeping well. Liver normal. Spleen reduced more in size, lower border could just be felt below costal margin. Discharged from hospital and instructed to attend once a week for further treatment.

January 31.—Looking quite well and feeling quite fit. Intravenous injection seven cubic centimetres of two per cent solution tartar emetic. No reaction.

February 7, 1922.—Intravenous injection seven cubic centimetres of two per cent solution tartar emetic. No reaction.

February 14.—Intravenous injection seven cubic centimetres of two per cent solution tartar emetic. No reaction.

Treatment stopped. A further blood count was taken, result as under: total red blood-cells, 4,450,000 per cubic millimetre; total white blood-cells, 13,125 per cubic millimetre. Differential count: polymorphonuclears, 62 per cent; large mononuclears, 9 per cent; lymphocytes, 26 per cent; eosinophils, 2 per cent; transitional, 1 per cent.

Owing to a hitch in the granting of a free passage to England, patient did not leave India till the end of April, 1922. I saw him just before he left Quetta and he was then looking and feeling quite well and strong. The spleen could not be felt below the costal margin, although on percussion it was still slightly larger than normal.

I am indebted to Colonel H. B. Fawcus, C.M.G., D.S.O., V.H.S., R.A.M.C., Officer Commanding British Station Hospital, Quetta, for permission to publish these notes, and to Major A. N. Fraser, D.S.O., R.A.M.C., D.A.D.M.S. (San.), and Assistant Surgeon A. L. Greenway, I.M.D., who carried out all the blood tests for me.

THE NEXT WAR.

BY LIEUTENANT-COLONEL G. W. G. HUGHES.

Royal Army Medical Corps.

I.

What of the next war? In spite of resolutions that "there must be no more war," in spite of Leagues and Conferences, who is sanguine enough, nowadays, to deny that the possibility of more war must be recognized and prepared for? It is almost a platitude to say that we must make use of our lessons in the past to prepare ourselves for the future.

It is a fact that there is a continual evolution in warfare. It is the aim of

each combatant to gain the superiority by using methods and weapons against which the other has no defence. Plans of attack and defence must be secret. The essence of success is surprise, either in strategy, in weapons, or numbers of troops. Numerous instances from the late war could be given. Two examples will be sufficient; the use of gas by the Germans, and that of tanks by us. Each new method or weapon necessitates a fresh means of defence, as, in the old days, the introduction of bronze and iron entailed the wearing of armour. It is possible to overdo this defence, as, for instance, when necessary mobility is sacrificed to weight of equipment.

Perhaps the most marked innovation of the war was the motor engine, and the vastly enhanced mobility it provided. Men, supplies, artillery and ammunition could be moved for distances and at speeds that had never before been thought possible. It is true that in France the warfare became more or less stationary as far as the front lines were concerned, but this was only possible because there was an equality of motor transport.

Then, too, never before in such a campaign was the artillery so markedly the principal weapon. Rifles and machine-guns, bombs and bayonets, caused only a small proportion of the casualties. As medical men we were surprised by the severity and the numbers of shell wounds.

Aircraft, with all their uses, were disappointing weapons.

II.

I have heard of a description of the next great war as being largely a war of tanks. They will be larger, more mobile, amphibious, and protected against shell-fire and gas. These will, it is said, be inevitably necessary as a defence against vastly increased ranges, accuracy, and intensity of the artillery fire of the future. There will be few obstacles capable of stopping them. It will be a case, presumably, of a species of naval warfare on land, with battleships and lighter craft.

We have all heard of, or imagined, a vast development of aircraft. Air battleships, air transports, machines that are noiseless, and that can remain stationary in the air, may be evolved before very long. It requires no extraordinary imagination to picture them.

Each of these developments will require its defence. Obstacles must be devised against the tank, and special methods for its destruction. More efficient anti-aircraft artillery must be invented.

But, after all, warfare will never entirely leave the ground on which we live. The vulnerable, comparatively naked infantryman will still be the pawn in the game, will always be the deciding factor. The horse must go, but man fights man.

It has, lately, been resolved that poisonous gases shall not be used in war. If warfare were a gentlemanly game, one could suggest many other rules to make it more pleasant. We are particularly interested in the Geneva Convention. Can we rely on each one of our possible enemies to observe its rules as we ourselves are ready to observe them? As far as I know we have always been strictly honest in our use of the Red Cross. But there are some countries that I can think of, that would be no better, and might be worse, than the Germans.

III.

We cannot expect to have shell- or bomb-proof hospitals in the field. I have known, however, abandoned tanks to be most useful as a regimental aid post, and as a dressing station. The provision of some such shelter in which to treat wounded is by no means so extravagant as at first it might appear. Certain small groups are worth protecting, the headquarters of a battalion or of a brigade, the signal office, and the dressing station. Dug-outs and shelters can be made in time, but they are immobile.

Our field ambulances must be able to keep pace with the rest of the troops they serve. If these troops be moved by motors (or airships) the medical units must be able to move as quickly. I presume it has already been recognized that horsed transport for field ambulances will be not only inefficient, but uneconomical.

We need yet, some simple, portable form of wheeled stretcher. The stretcher itself still leaves much room for improvement.

It is more than possible that any kind of hospital may have to be very much farther from the front line than we have been accustomed to. We should make certain that our motor ambulance cars are better designed for the work, are of a standard pattern, and are sufficient in numbers from the very beginning.

It is probable that the narrow-gauged light railway will be used far more than hitherto. This would make it unnecessary for hospitals to be near ammunition dumps and camps, legitimate targets for shells and bombs.

What have we learnt in the way of military surgery? That strong antiseptics are useless and harmful to a wound. That shock requires as much, if not more, immediate treatment as the wound that produced it. That some operation is necessary for practically every wound, and the earlier it is done the better. That nurses can be trained into very efficient anæsthetists. That we need a new type of operating lamp. These are a few of our lessons.

Then as to medicine. A very large proportion of our sickness was due to dirt. Trench fever, skin affections; we should have been well off in France without these. There does not seem to have been any attempt made, before the war, to provide for the washing of men and their clothes, and for disinfestation on a large scale. The spray baths that proved so useful were of French design. The Foden lorry came on the scene none too soon. The starting of baths and laundries was mainly due to medical initiative. The personnel for running these institutions had to be found by medical units, and it was only with the greatest difficulty that badly needed medical officers and men were replaced by others. Does the "Q" staff yet realize that these necessities of every army, small or large, are not part of the responsibilities of the medical service, and that it does not take many days of fighting to qualify a man for a bath and clean clothing?

So much has been written lately in the *Journal* on questions of administration and organization, that it is not necessary for me to indicate lines for improvement. I will only suggest that older men might be used as D.A.D.M.S.s without impairing the value of the work done. We need the younger men elsewhere.

It may not be possible to be sufficiently prepared for the unexpected. We can, at least, perfect our preparations for what we know will be inevitable. At

the same time we must realize that our arrangements should be capable of expansion or modification to meet completely new conditions. Our mobilization equipment has to be available for so many parts of the world and so many varieties of climate. We are liable to "savage" as well as to more "civilized" warfare. It would appear to be a mistaken policy to provide a complete equipment for universal use. A field ambulance may be properly equipped for France, but not for Africa. We should decide on a foundation which can be rapidly built upon to meet the particular conditions.

Travel.

AROUND THE WORLD.

BY LIEUTENANT-COLONEL C. R. L. RONAYNE.

Royal Army Medical Corps (Retired).

(Concluded from p. 237.)

March 19: I have had several enjoyable days at the Thorndon tennis club, of which I have been made an hon. member.

To-day I had one, Mr. B—— to lunch, after which he took me for a drive in his fine car. We went through delightful mountain scenery, the car climbing the steep roads as smoothly as if it was on the level. Here and there we came on superb views of the harbour, city, and surrounding country, to describe which would tax even poetical eloquence. After about an hour's run we fetched up at the tennis club where we had a four arranged.

One cannot help noticing as one travels through Australia and New Zealand, that women do not smoke—at least nothing like as commonly as at home just now. Why, I cannot say. I do not believe it is due to bashfulness, want of freedom, or want of being up-to-date. In the restaurants one sees the women—many of them merely emerging from the flapper period—enter alone, or in couples, nearly always carrying a small suit case, and occasionally a vanity bag; they sit at the tables alongside men of all ages and descriptions without taking any notice of them, or being in the least disconcerted. These are the typist and business classes. But the Gerties and Berties "doing" George Street and Pitt Street, Sydney, in the afternoon lack nothing in up-to-dateness by comparison with their brothers and sisters "at home"—even the accent (which is often tell-tale) is all that could be desired. The same frills, fluff, and chiffon can be seen any afternoon in George and Pitt Streets just as in Bond Street. The same greetings too—"That you, old bean? hav'n't seen you for an age, where shall we have tea?"—but at the tea Gertie does not smoke. So it is not due to want of being up-to-date. At the various tennis clubs

I have been to I have seen a good number of ladies, but only one lady have I seen smoking. Could the explanation be that women on the whole do not care for smoking (the exception proving the rule) and that they have given it up in Australasia for the same reason that Gladys Mayfair gave it up—"Auntie, I am giving up smoking; you know, Auntie dear, I never really did care for it, and now that it is so common amongst girls it is impossible to shock anybody by smoking, so I am giving it up altogether."

But musing in this way reminds me that women are of the *anabolic* diathesis whilst men are of the *katabolic*—so I wonder if there is any danger of our football, hockey, cricket, etc., women revolting as Gladys did. It seems unthinkable! One shudders to think of women giving up sport, and, as Marie Corelli would express it "getting back to the nursery." Anyway they have given up smoking in Australia, and there seems to be a definite wave of domesticity sweeping over the women of that country with its crest at present at Sydney—which is all the more significant as Sydney is a very gay (I nearly said naughty) place.

By the way, talking of ladies; at Sydney I noticed several carrying small stiff cases which looked for all the world like cases for field glasses. They are substitutes for the usual vanity bag—but I cannot recommend them as they are very unsightly. Still they are roomy and easily carry all the usual equipment of the vanity bag—powder, puff, rouge, mirror, corkscrew and pack of cards.

Monday, March 20: The good ship is now well laden with a cargo of frozen mutton, apples, and bales of wool, so we said good-bye to Wellington to-day at 2.40 p.m.

As we moved out it was blowing hard from north-west with blinding rain squalls and coldish. (It should be remembered the climatic conditions we have experienced "down under" correspond to the summer and autumn at home).

We are shaping our course for the Panama Canal.

Monday, March 20: A very unpleasant day; the north-west gale we had when leaving Wellington yesterday has continued and clouds of spray are continually drenching the ship; with every now and again a heavy green sea sweeping the deck. The rolling is horrible.

Anybody who has been to sea knows well how time slips by, and how easy it is to get mixed up in one's days and dates; but it is not due to any such confusion or "clerical error," that I called my entry of yesterday the 20th and to-day the 20th also; the fact is, we have just crossed latitude 180°, and as we are going East we thereby gain a day. And so, though yesterday was Monday, 20th, we have to call to-day Monday, 20th, also; if we did not do so, we would arrive home on (say) May 3 according to our reckoning, whereas it would really be only the 2nd. Seems funny, but it's true. If we were sailing in the opposite direction, that is going west, we would lose a day.

March 29: After lasting for three days the north-west gale abated,

and the weather has since been very pleasant, if a trifle cold; but as we are going in a north-east direction, and so approaching the tropics, it has gradually been warming up, and yesterday it was quite warm—with the result that yesterday morning only three albatrosses out of the eight which had been accompanying the ship remained; and as it is still warmer to-day, all have now disappeared. They had accompanied us all the way from New Zealand—where have they gone to? There is no land anywhere about for them to go to, except some islands hundreds of miles to the north; but as they left us on account of the increasing heat, they would not go to these islands which of course would be hotter still. Did they go back to New Zealand? A little trip of over 2,500 miles! I wonder if ever an attempt was made to introduce albatrosses into northern latitudes?—if so, it failed, as they are to be found only in the southern seas. In these days of fast travel, not much notice is taken of these fine birds, but in the days of the sailing ship, I believe sailors spent much of their spare time trying to catch them; they used to make pipe-stems from some of the bones, and tobacco pouches from the webbed feet. But harmless as they look gliding about the ship, the man who falls overboard has usually a pretty thin time of it between sharks below, and albatrosses above. It is said, with their powerful beaks they can break a man's skull. There is a huge specimen in the museum at Melbourne, mounted in the position of gliding with outstretched wings; it looks very fine, and is fourteen feet from tip to tip of wings.

April 2: We have changed into white drill, as it is gradually stoking up, but a fresh breeze from the east tempers the air to-day. This morning had a severe tussle with a molar. Whenever I tugged, the ship seemed to rise, and it was suggested I was using so much force I was pulling the ship right up, and she may capsize—so shifted the man to amidships and then succeeded in getting it out.

April 6. Very heavy rain yesterday, cooled the air temporarily, but it is very hot and "muggy" to-day.

As long as a ship has a well stocked library it is ridiculous to say time passes heavily at sea—here is an extract from an article on "Wealth and Expenditure" in a book called "Modern Problems" by Sir Oliver Lodge, which I am reading: "It may be said roughly that men earn the money and that their wives spend it: a fair division of labour. They spend it best: and if the man insists on retaining and spending much of it, he is liable to spend it very far from wisely or well." A simple truth beautifully expressed—but I wonder how many married officers will show this extract to their better halves!

April 7: The run from Wellington, New Zealand, to Panama is 6,488 miles, and is the longest recognized trade-route there is without seeing land. Occasionally mariners set their course so as to pass within sight of the Galapagos Islands situated on the Equator—and as it happens we are passing close to them to-day; through a sea of oily calmness. And

the sight of land, though such desolate islands, is very welcome, so we scrutinize them carefully, especially the larger ones, Espanola and San Cristobal. One does not require to be told they are volcanic in origin, as several small peaks with their tops cut flat have a very cratery look. According to Darwin there are no less than 280 craters—I noticed only 279 as we shot past. The islands as we saw them are covered with a sort of scrubby bush; but no regular trees, nor grass. San Cristobal is inhabited by a few hundred people, but we could detect neither houses nor fishing boats, though we passed fairly close.

A great variety of birds put off to meet us as we approached the islands, more selfish merely to inspect, but the great majority to greet us after our long voyage. As I have never been a bird lover in the full sense of the word, I cannot say that I really notice the absence of a decent ornithologist on board. I am satisfied with the information I pick up from "old sea-dogs." Were I to ask an ornithologist the name of that bird now passing, he would reply—"Oh! that is the '*Feliparia Peliculalis*,' " a species of the well-known family of the "*Laridae*." But my old sea-dog friend calls him the "scissors bird"; and I must say, his long bifurcated tail is remarkably like a pair of open scissors. Another bird he points out as the "bo'sun bird," so called on account of his long narrow pointed tail being like a marline-spike. And so on. We wave to them and they flap their wings in return.

Great numbers of dolphin are disporting themselves. It is an exceedingly pretty sight to watch them playing round the bow of a ship (they can be seen only by going right to the bow and looking straight down). When so playing they always keep within a few yards of the bow; darting across it, swerving this way and that, swimming on their side, and frequently swimming turned completely upside down, jumping out of water, etc. They keep perfect pace with the ship, and as they are quite close to the surface, every movement can be plainly seen.

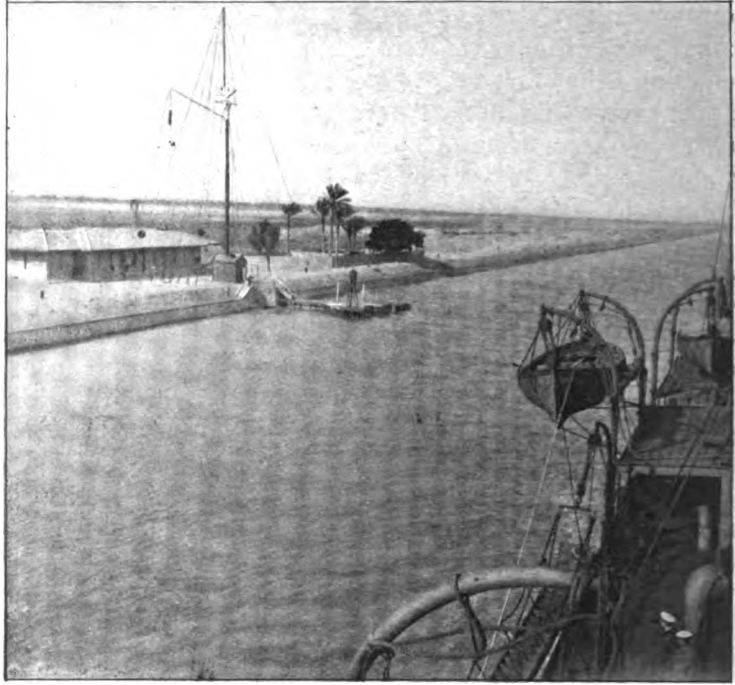
Their antics are so varied and so obviously playful, there can be little doubt that they are playing—but it is said also, that they are rubbing their backs against the bow of the ship in order to remove sea-lice and animalculæ growing on them; and I think it is very likely they combine business with pleasure, because if carefully watched they can be seen in several of their side swerves and darts to strike the bow a glancing blow or rub with different parts of their bodies. If I remember rightly passengers are not allowed forward on to the fore-castle—if so, it is not possible to watch this very pretty sight. But perhaps to do so might be arranged as a favour.

April 9: The bo'sun tells me that yesterday he saw a whale quite close to the ship, and assures me he was longer than the ship. The bo'sun may have his faults, but he is at all events an upright man, and I have every confidence in him: so there can be no doubt but that the whale was at least 461 feet long. The record, so far, is the one in the British

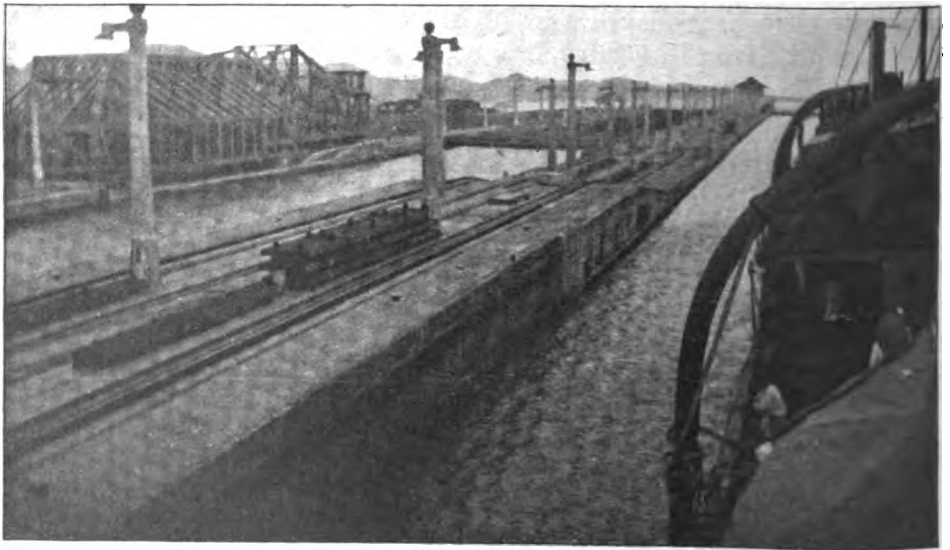
Museum which measures eighty-five feet over all—a mere pup alongside the bo'sun's one!

Last night after dinner we were having the usual smoke and chat; we were discussing Einstein's theory of "relativity," when it was announced the ship's cat was missing. This announcement cast a general gloom over the company. Her many virtues were recalled and approved *nem. con.* How she never missed a rat. How she—etc., etc. All the senior officers present agreed that cats' days are numbered once they acquire the habit of going into the ship's life-boats (as Sophia had); that in climbing up they cannot get a proper grip on the hard iron davits and that sooner or later during a roll of the ship, they lose their grip and over they go. This led to the suggestion that wooden davits should be supplied. When this question of cats and davits had been fully discussed, we did not revert to Einstein's "relativity," but had a discussion on the abiogenesis theory of Huxley, which led on to earthquakes. Blood-curdling descriptions were given of how ships in port had suddenly found themselves high and dry; whilst others were sucked out into deep water, only to find themselves thrown back on to the land. It was pointed out that the Panama Canal is right in the thick of the earthquake belt, and conjectures of our being suddenly sucked into one of the side lakes were indulged in. It was pointed out also that we might be swished through at such a rate as not to allow time for the canal dues to be collected, and that the possibility of this happening was considerably enhanced, as the American authorities are notoriously slack at collecting their dues. So the P. and O. Company can only live in hopes that this fortunate earthquake may turn up.

April 11: Yesterday we went through the Panama Canal. To properly appreciate it, I think, it is necessary first to go through the Suez Canal. After being buffeted about on the high seas, it is an interesting novelty to suddenly steam through a desert on a narrow strip of water, such as the Suez Canal. But except for this novelty, the canal does not appeal to the tourist or non-scientific mind at all. The tourist may wonder at the great number of shovelfuls of sand that had to be dug up, and wonder the men did not get dizzy from such constant digging; but this would probably be about the limit of his scientific wonderings. But how different the Panama Canal! All along the route one has thrust on one, not only the wondrous feats of engineering in making the canal, but the wondrous efficiency, rapidity, and smooth working of the great locks by which the largest ships are raised up eighty-five feet, passed along through about forty miles of canal, and again lowered to sea-level. Even the parts of the canal which do not actually assist in getting a ship through, attract attention and admiration—for instance the large 100-ton floating cranes, and the many "emergency" locks; these latter are huge steel structures containing complicated machinery, and constructed at the side ready for use. They are so beautifully kept with paint and oil, they look as if they



IN THE SUEZ CANAL.



IN THE PANAMA CANAL: ON THE LEFT CAN BE SEEN ONE OF THE LARGE STEEL STRUCTURES MARKED "EMERGENCY LOCK."

had been only just handed over by the contractors; the same for the cranes, and indeed everything connected with the great work, whether in actual use, or provided only for an emergency or accident. The usual tugboats one is accustomed to see manœuvring ships in docks are nowhere employed; the manœuvring is done by curious, massively built engines—much resembling “tanks” in appearance. These move along the concrete banks, or quays, on a deep-toothed cog-rail; and in the course of their manœuvres, often have to climb up very steep slopes. They are worked by electricity of 40,000 voltage—in fact everything is done by electricity, bar the shouting, and that’s not done at all, so perfect is the organization.

Six of these engines (three on each side), took hold of us with steel hawsers, and—but I notice I am being drawn into a detailed description which I must resist. Everybody who has been through the canal is agreed it must be traversed to be appreciated, because, by doing so, not only are the wonderful engineering feats seen and appreciated, but it is only by seeing one can form an adequate idea of the great natural difficulties and obstructions which have been overcome—such as the Culebra Cut; and can understand how the river Chagres has been harnessed, and turned to more than one use. Last, and perhaps not least, is the scenery. There are several islands dotted about the north end of the gulf of Panama, which are very picturesque owing to the rocks being covered with a lichen of a pale blue tint, surmounted by rich verdure in various stages of autumnal hues. Close to the entrance to the canal are three truculent looking islands close together, which, I was informed, are heavily fortified with sixteen and eighteen inch guns. Barracks can be seen close by. The canal itself is bordered for most of its way by bold mountainous hills clothed in thick tropical verdure of every shade and description. Some places in the Gatun Lake are of extreme beauty, and taken all round, the canal may well be described as a “beauty spot” and well worth a visit, if only for this reason.

At any sea-port town may be seen small sailing ships moored to the quay, and men discharging coal from them by means of baskets carried along a plank; in this way it usually takes about a week to ten days to unload 200 tons. Contrast this with up-to-date methods! Thus, as soon as we had come through the canal we went alongside the coal-wharf at Colon, and there took into our bunkers 200 tons of coal in exactly *fifteen minutes*. A steel chute was first put in position, and though it was very big, and looked complicated, it was easily and quickly manœuvred. Then railway trucks of special construction, ran along on overhead rails, and as each truck came opposite the chute it discharged itself into the chute, which in turn discharged itself into the ship’s bunker. The trucks ran along the rails, and also automatically emptied themselves into the chute by means of electricity. An official told me the record for loading at Colon was 1,000 tons put into a White Star Liner in seventy minutes. This was very fast, considering that the position of the chute had to be

changed for the different bunkers. Evidently Colon is the place to take coal on!

April 13: The chief "freezing" engineer (Mr. McK.) showed me around his department to-day. As this department has to keep all the holds where the 100,000 frozen-mutton carcasses are stowed at a constant temperature of 20° of frost, the "plant" is, of course, a very powerful one. In the freezing engine-room though the thermometer on the wall showed a temperature of 108° several parts of the engines were coated with thick icy snow. After explaining the mechanism, he opened a thick insulating door, and on stepping inside we were immediately in a temperature of 20° of frost. It would be difficult—in fact impossible to describe one's sensations on going at one step from a roasting temperature of 108° to one of 20° degrees below freezing. It was an extraordinary feeling—and equally extraordinary returning again to the heat. This was the "recording" place, where the temperature of the different holds was shown—but it looked more like a cave in the Polar regions, as everything was covered with snow and long icicles. In the heat of the engine-room my white drill got moist (not to say wet) in several places from perspiration; and in the "recording" department, though we were little more than a minute there, the drill was frozen stiff. Altogether a very interesting show.

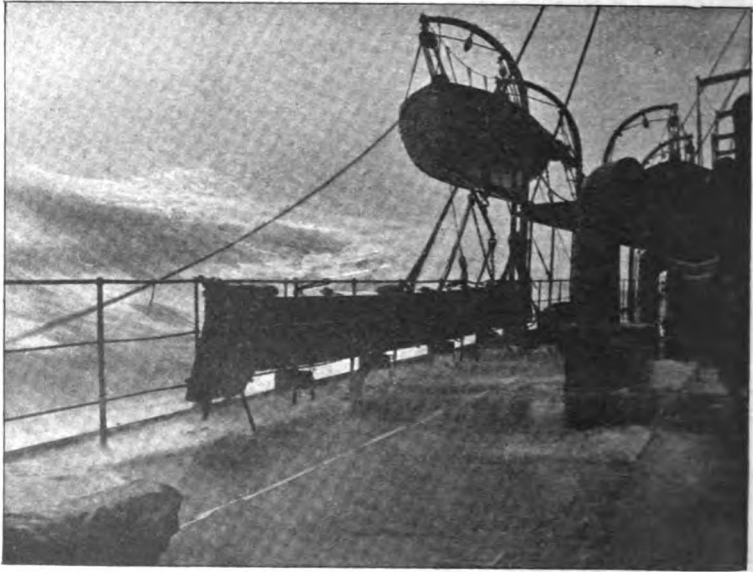
April 14: To-day we passed the Bahama Islands. These are typical coral islands—that is, low land with hardly any hills; and islands long, narrow and "snaky" in shape, with rockless beaches. Not very interesting to look at. We passed quite close to several of them, and I suppose it was this, together with the calmness of the air and water, that made us in rather a reflective mood at lunch. We pictured how Columbus' crew wearied by many months without seeing land, and reduced to mutiny by mouldy biscuits, bully-beef, and plum-and-apple, were about to kill him. How he pleaded for only *one day* more. And how after a sullen consultation amongst themselves, the crew granted his request. And sure enough, next day, with lee-scuppers nearly awash, and the spanker drawing nicely, they fetched up the Bahamas—the first land discovered in the west! By the way, an interesting book to be seen at Seville is the diary or log-book of Columbus. I forget now whether it is in the Alcazar Palace, or in the museum. It is in a glass case with two pages lying open, being held back by tapes. It is very clearly written, and, according to the particulars given underneath it, is in the hand-writing of Columbus himself. I tried to take a photo of it, but unfortunately it did not come out well.

April 18: It is said a man is known by his clothes—America may be known by its ships. On the 17th, as we steamed into Chesapeake Bay, the roads were literally "stiff" with schooners. Most had three to four masts, one had as many as six; and some said, one in the distance had thirty. One schooner we simply could not shake off—we overtook her, and passed very close to her—then when we eased up for the pilot, she appeared

right on our port bow. Later on when we eased up to let a railway train pass, she bobbed up under our starboard quarter. The train consisted of eighteen saloon carriages on a pontoon, towed by a tug; they might have been going to England, as they were heading in that direction. Those Americans are go-ahead—fancy meeting trains on the high seas! We passed another soon afterwards. But the schooner that hung on to us was a four-master, and, with all sail set, she made a very pretty picture, leaning over and cutting up the foam in the stiff breeze. Each time she drew near she came very close to us, and on different tacks—so some good “snaps” could have been got—but, unfortunately, nobody on board had a film. Eventually we fetched up at Newport News (Virginia), where we went ashore in the afternoon. The town has a population of about 30,000, and its attractions may be summed up in one word—*nil*. But as I had not been to America before I was interested to see the ways and customs of the people. What I think interested me as much as anything in this rather uninteresting place was the black people. Not that I had not seen dusky skins before—many of them. But I have never seen anything so comical as the get-up of many of the American blacks. Both sexes strike many an original idea in the dress line, but I think the palm must easily be awarded to the ladies. One good lady had on a straw hat much like those worn in (I think it was) the eighties. It was canted forward, with a slight rake to starboard. A large pin or marlinespike passed through behind, and clewed it down to what looked like a tuft of black oakum. Round her neck she had a *mediché* collar, with puffed-up sleeves, standing up from each shoulder. A “bustle” about three-quarter size was carried behind. But what gave the finishing touch to the picture was her gait and face. She had just a trace of an “Alexandra limp,” combined with the shoulder-thrusting stride so characteristic of the modern “public school” girl; and her honest black flat face, wreathed in smiles, benignity, and utter self-contentment, was the crowning touch. But this is only characteristic of many such comical sights. And it is the large black face, with its happy look and air of perfect self-satisfaction, which gives the real comical touch to many a weird get-up. By the way, if Newport News is typical of other parts of America, the white man will have to look to the size of his family if he wants to hold his own. I was surprised at the large number of coloured people about. At night had a very good dinner at the Warwick Hotel for 1.60 dollars.

This morning at 10 a.m. we cast off, and shaped our course for London. As we steamed down Chesapeake Bay, the same crowd of schooners was about, also the trains being towed on pontoons. I believe they go from Newport News to Norfolk and other places. It is said the Americans are selling or scrapping the large number of sailing ships they built during the war—but there is not much sign of their doing so here. We also passed a fine, and beautifully kept, U.S.A. Admiralty yacht. All white and shining brass.

When we were arriving, the Americans provided us with a thrill—that was, the trains on the pontoons; and I somehow felt they would not let us go without providing another—and right enough they did! This time it was in the form of an Admiralty tug towing a schooner, lying completely on her side, with just the tops of her four masts showing above water; our pilot said she had been towing her for *four days*. Surely an unparalleled record, at all events, amongst the Admiralties of the world for towing a capsized ship! “It’s dogged as does it.” This reminds me of the story of the American who was travelling in a train with a Scotchman, and was “crabbing” everything British. Looking out of the carriage window he pointed to the Forth Bridge, and said: “Say, mister, what’s that thing over the river; it looks like a bit of a cobweb?” Scotchman looking intently at the Bridge, replied: “I don’t know; (after a pause), it wasn’t there yesterday.”



STORM IN THE ATLANTIC: A HUGE SEA ABOUT TO BREAK ON THE SHIP. THE REMAINS OF A PREVIOUS SEA CAN BE SEEN SWISHING ON THE DECK.

April 21: On the night of the 19th, without any warning, we suddenly ran into bad weather. The first intimation I had that anything was up, was when a wave came in through my port, flooded my bed, and generally created havoc. We spent a pretty thin night of it bumping about in our bunks. Yesterday the storm continued with unabated fury, and mountainous seas came rolling at us with hissing white crests, and in never-ending succession, each seeming to say, “Well, as the last sea failed to swamp you I’m going to do it.” Sometimes the ship seemed half buried,

and we shipped much heavy water—but little damage was done. To-day there is a goodish swell remaining, but all the wind is gone and it is gloriously fine.

I wonder how many amateurs get a really representative photo of the great seas as they roll on a ship during a storm—I should think only a very small percentage. Of course there is a lot of luck in photography of this sort—and one may easily spend years going to sea and not be able to hit off the necessary combination of conditions to obtain a good picture; and even if the light happens to be good enough, the difficulties and uncertainties of getting a good picture are still very great. For instance, the one here shown (see photo) is the only one of six exposures which turned out any way satisfactory. The others were either fogged by spray, or taken at the wrong time, or light too bad—and so on. All were taken under great difficulties; thus, I had not only to dodge drenching sprays, but had frequently to run for dear life to avoid being swept off my legs by heavy seas; add to these, rolling and lurching in all directions.

It was only when we arrived in Australia that we got orders to go on to New Zealand and home *via* the Panama Canal. This was good news for one of our quartermasters (quartermaster is the modern expression for able-bodied seaman), as he had a married brother in New Zealand, and he seized the opportunity to remain with him. So this left us minus a quartermaster in a distant land. A local shipping company recommended a man, whom we agreed to take, and just as we were about to leave Wellington our hero came on board. He announced himself as a Greek, and he was a typical Greek to look at; so not unnaturally there was some prejudice against the chap—but he soon enough lived it down, as he proved himself efficient and reliable in his work, and of a cheery disposition. His name is Nicholas Calogaras, and his story is as follows: He was born on a small island called Paza, belonging to Turkey. Forty-two years ago he left the island and went to sea, leaving behind him on the island two married sisters. A few years after he left, the sisters with their husbands shifted to Greece: and as the Turkish postal arrangements on the island were not the best, addresses were not noted and letters not forwarded, with the result that a regular correspondence, which had been kept up between Nicholas and his sisters, was cut short; and he lost complete touch with them, though he continued to write off and on for a few years in the hope a letter by chance might find them. After about ten years at sea, he married in New Zealand, and settled down there and got an appointment in the railway, from which he recently retired on pension. They must have been an affectionate family, for one of the sisters, as soon as her son was sufficiently grown, sent him to sea specially to see if he could trace Nicholas—but all in vain; though he spent three years at sea, and in that time went to almost every country in the world, and made inquiries at every port—at every port except in New Zealand! So brother and sisters were completely lost to one another for forty long years. About six months ago Nicholas was

talking to a Greek sailor off a ship in Wellington harbour, and the sailor made some remark in reference to Nicholas' surname (which is, it appears, an unusual name in some parts of Greece) and one thing led to another, and soon it was clear the sailor knew Nicholas' sisters, with the result that long letters have recently passed between sisters and brother; and Nicholas has for the past few months been pacing the docks in Wellington in the hope of being taken on as a hand on some ship, and so working his passage home—and now the dream of months is being realized; and he is confident he will easily be able to get another appointment on a ship going from London to Greece, and so home. In the meantime a nice wife and family (they all



NICHOLAS CALOGARAS RETURNING TO SEE HIS LONG LOST SISTERS.

came down to the quay to see him off) await his return to Wellington. All on board wish him the best of luck, as he is a very worthy man in many ways.

April 30, 1922: A little more than four and a half months ago we steamed down the Thames—to-day we steamed up it. During this comparatively short time we have covered nearly 26,000 miles of tractless ocean—yet, *en route*, we arrived every time at our appointed port exactly to time. What wondrous improvements in navigation and travel since Pythagoras first dabbled in astronomy and Noah won the first ocean race to Ararat!

At 6 p.m. we moored in the Victoria Dock—the end of a very pleasant voyage around the world.

Current Literature.

General Immunity by Local Immunization. By A. Besredka, *Bulletin de l'Institut Pasteur*, No. 12, June 30, 1922, tome xx.—The author points out that the theory of immunity being due to antibodies in the serum cannot be accepted as the full explanation in all cases.

He also shows that in certain infections certain organs of the body are alone susceptible to the particular infection and that if these organs, e.g., skin, lungs or intestine, can be directly immunized the whole body remains immune.

(a) *Anthrax*.—He finds that the guinea-pig is exceedingly susceptible to infection through the skin. Large doses of vaccine can be injected into the peritoneum but the animal can still be infected just like the control.

In order to protect the guinea-pig as a whole it is necessary to vaccinate not under the skin or into the peritoneum but into the skin; by this means a solid immunity is provided.

If one could imagine a guinea-pig deprived entirely of skin envelope and still alive the body would be immune to infection by anthrax—the skin alone is susceptible.

The skin alone is concerned in the process of immunization; unless the vaccine is introduced directly into the skin immunity will not result.

From these observations Besredka argues that to immunize an animal against a bacterium it is necessary to bring the vaccine into direct contact with the special organ which is susceptible to that organism.

In vaccinia also it is necessary to inoculate the vaccine into the skin, scarification—then the typical reaction appears and immunity is established; not so if the vaccinia is introduced directly into the peritoneum if precautions are taken to avoid infection of the skin en route; the animal so vaccinated does not produce immunity, as can be shown by the application of the vaccine to a scarified area of the skin. In this instance, although antibodies can be demonstrated in the blood, Besredka is of opinion that these are not the source of immunity but rather that the vaccination has rendered the skin (the usual route of infection) and the susceptible organ, insusceptible. These antibodies disappear in the course of a month or so, the immunity remains.

As regards the defence of the body by the epithelium of the lung, Besredka shows that the lethal dose of diphtheria bacilli by the pulmonary route is ten times greater than when the bacilli are injected into a vein.

But if the epithelium of the lung is damaged, for example by bile which strips the epithelium, a dose 100 times less will then produce a fatal issue by the pulmonary route. It is thus a question of local immunity or protection.

As regards diphtheria two series of guinea-pigs were taken, one lot were immunized by the tracheal route, the other by injection of dead bacilli under the skin—the first were found to be immune, the second lot all succumbed to the test dose administered by the tracheal route.

He considers that this survival was due to an immunity acquired by the lungs as a result of the local (tracheal route) application of vaccine.

By this local immunization of the susceptible organ one achieves the general immunity of the body as a whole.

Reviews.

THE ROYAL FUSILIERS IN THE GREAT WAR. By H. C. O'Neill, O.B.E. London: William Heinemann, 1922. Pp. xiv and 436, with twenty illustrations and four maps. Price 21s. net.

The author has prepared a comprehensive work detailing the war record of some fifty-nine Royal Fusilier battalions whose personnel reached the enormous total of 235,476 and served in every theatre of war except Mesopotamia. The dead numbered 21,941.

As stated in Chapter I, "so great is the roll of the regiment that it may be taken to be the British Army or, indeed, the British race in little. If you seek men of leisure, you may find them here; if sportsmen, here they are; if bankers, accountants, stockbrokers, lawyers, men of science, administrators, poets, writers or 100,000 cockneys grousing in a characteristically hearty manner and concealing a wealth of heroism and kindness under a proper protective irony—here they are."

The book is dedicated to H.M. King George V, Colonel-in-Chief, Royal Fusiliers, and contains as frontispiece an excellent photograph of His Majesty.

The illustrations include photographs of Major-Generals Sir Geoffrey Barton, Sir Reginald Pinney, Sir W. B. Hickey, Sir Sydney Lawford, and of Captain R. Gee, V.C., M.P., and other well-known soldiers, and a lifelike sketch of General Townshend.

In the preface the author refers to the difficulty of dealing with his huge subject in the space at his disposal, and also states that "in this fascinating though laborious inquiry I have been struck by nothing so much as the terrible disproportion and fundamental injustice of the awards," and this although according to a table given in the appendix the following decorations were awarded: V.C., 13; C.B., 7; C.M.G., 18; C.B.E., 5; D.S.O., 112; M.C., 592; D.C.M., 343; M.M., 1,699, etc.; in all, a total of 838 Decorations and 842 Mentions in Despatches for Officers, and 2,457 Decorations and 460 Mentions in Despatches for other ranks.

Three Victoria Crosses were gained in one day at Cambrai.

The book is written in narrative and rather lax style and deals with every important engagement, whilst singling out the more significant incidents.

In the appendix the Roll of Honour of the regiment is given, and also a special chapter giving the record of General Officers, whilst in the concluding pages extracts from letters and diaries of officers and others are given.

The book does full justice to the subject and should be very much appreciated by all who have served in the Royal Fusiliers. On the other hand, the difficulties experienced by the author in presenting his subject make it somewhat difficult for the general reader to obtain a composite picture.

In one or two places complaint is made of credit really due to the Royal Fusiliers being given to other regiments. It seems a pity to introduce controversial matter in a work of this kind.

One is disappointed that in the war record of some 235,000 men of whom nearly ten per cent were killed, almost no reference is made to the work of the medical service in the front line—although two medical officers who received decorations are referred to.

The book is well presented, the type is good, and the index is full.

A. D. S.

A GUIDE TO URINARY DISEASES. By A. Abrahams, O.B.E., M.D., M.R.C.P., and A. C. Morson, O.B.E., F.R.C.S. London: E. Arnold and Co., 1921. Pp. vii and 120. Price 4s. 6d.

This little book is a compact clinical guide to the study of diseases of the urinary tract. It does not pretend to go deeply into the pathology or to give details of the more elaborate chemical tests, as, for instance, the tests for blood sugar or blood urea; but efficiently deals with the subject from the point of view of the busy practitioner.

The first six chapters deal with the urine, its normal characteristics and variations and its appearances in abnormal conditions. The remaining chapters deal with the abnormalities of micturition, the estimation of renal function, nephritis and suppurative conditions of the kidneys, bacteria, tuberculosis, cystitis and bladder tumours, diseases of the prostate, stricture and stone in the urinary tract.

An error has crept in on page 42, where it is said that urea is normally present in the blood to the extent of 0.3 to 0.1 per cent.

J. C. K.

FUNCTIONAL NERVOUS DISORDERS. By Donald E. Core. Bristol: J. Wright and Sons, Ltd., 1922. Pp. xiii and 477. Price 25s. net.

The latter-day biological conception of the problems of mental disease in general is in evidence in the book before us, which sets forth a distinctive view of the definition and classification of the functional nervous disorders. These are classified into a regressive group comprising the hysterias and a progressive group which includes the dysthymias and the mnemoneuroses. Emotional control is throughout considered as the great factor which distinguishes human from animal behaviour, and deficiency of such control allows certain aspects of human behaviour to regress towards that which is normal in animals but hysterical in the case of human beings. In an emotionally uncontrolled individual, primary, secondary and tertiary hysterical manifestations will be associated respectively with uncontrolled emotional tone, bodily discomfort or expectation of bodily discomfort.

In the progressive or sympathetic group, pictorial memory and the possibility of fear, both dependent on the acquisition of emotional control, are concerned in the production of the characteristic symptoms. The dysthymias include the confusional and introspective neuroses; these result from conflicts between the distortion of instinctive cravings and herd instinct. In the mnemoneuroses an atmosphere of dread or worry is the essential psychological factor; these disorders comprise the worry and obsessional neuroses and are marked clinically by hyperpiesis and pain. The dysthymias if untreated tend to pass into the mnemoneuroses, and similarly, dysthymic symptoms may come to complicate the mnemoneuroses. Sub-hysterical degrees of emotional uncontrol form a connecting link between the regressive and progressive groups, and may also complicate the progressive conditions. The progressive conditions are liable to end in arteriosclerosis. The author contends that the individual who is abnormally subject to continued worry or dread is a psychological failure in the struggle for existence and that nature destroys a thus useless individual, his removal being mediated by the sympathetic nervous system which raises the blood-pressure with resulting arteriosclerotic involution of the heart, brain and kidneys. Such broad views cannot fail to interest. The author's views on the genesis of the functional nervous disorders differ from those prevalent contemporary opinions on the matter which are biased in favour of a psycho-sexual ætiology. He does not consider the latter to be of predominant importance, at least in this country. Such matters as diagnosis, prognosis and treatment, etc., are considered in the concluding chapters. There is an interesting chapter on the distinction of the functional

nervous disorders from alienism and some organic conditions. As regards the epilepsies we consider that such points as conjugate deviation of the eyes during a fit, and a transient extensor plantar response after one, are worth passing mention, *re* the differentiation of true from hysterical epilepsy. Even the common phenomenon of evacuation of the bladder during a fit is a fairly reliable criterion in the opinion of most neurologists but is not mentioned. This book is a notable contribution to psycho-neurology and the author's views will be carefully examined by all interested in the subject. The book is quite luxuriously printed and got up and in every way a pleasure to read.

H. G.

Correspondence.

THE CITRUS INDUSTRY IN SOUTH AFRICA.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—Before leaving for South Africa I was asked by so many brother officers to let them know my experiences, more especially those in relation to the citrus industry which is now so extensively appealing to the British public and particularly to Service officers for support, that I feel a letter in the Journal may be of general interest.

I left England in the s.s. "Umtata," Natal Direct Line, on February 14, and after an uneventful voyage disembarked at Durban on March 15. From there I made my way to Maritzburg, where I remained for close on a month, looking at various small properties and residential plots with a view to settling near the excellent schools and University in this district. Not having found anything quite suitable, I proceeded to Johannesburg in order that I might arrange with the Directors of the Letaba Estates an inspection and visit to their property. It is not possible for me to overstate the kindness and attention I received from one and all of the officers connected with this Company, both on arrival, when I was met at the railway station, and throughout my entire stay both on the Estate itself and journeying to and fro.

I left Johannesburg at 3 p.m. on Sunday, April 23, and arrived at Tzaneen 5 p.m. Monday; as this train did not proceed farther, I was met by the Acting Manager and taken the remaining twelve miles by motor.

I found myself quartered in a well-built bungalow about 300 feet above the irrigated land, commanding a magnificent view of the whole property.

During the following days I had opportunities given me of seeing land in every stage of preparation from the rough veldt in process of clearing of bush and stumps to the planting of the trees in the cleared and most accurately levelled ground. So far as I could judge nothing was being left to chance and no precaution was neglected to ensure the ultimate results.

Work is not quite so forward as was anticipated originally, the following unexpected obstacles having been encountered:—

(1) The main furrow was a much bigger engineering proposition than was estimated.

(2) A delay of about three months owing to obstructions by an adjoining property owner regarding a canal through his land—now happily overcome without litigation.

(3) A vast amount of expensive work in levelling ant-heaps—some I saw the size of a moderate two-storied cottage.

Now, however, all classes of work are progressing rapidly.

There are nineteen teams of the Company's oxen, as well as others working under contract, in daily use, stumping, clearing, ploughing and levelling, also eighteen white men and 300 natives. Three hundred and ten acres are already planted and work is going forward at the rate of from twenty-five to thirty acres a week. All young trees are passed by a Government inspector before planting. Every tree is actually planted and handled personally by an expert horticulturist—in fact, if I were to enumerate in detail all the steps and precautions I myself saw being taken to ensure the results which the Company as trustees for plot-holders are using, I would far exceed the space I hope you will allow me.

As regards the climate and soil. I was taken round estates bordering on Letaba and saw orange trees six years old carrying from about 200 to 300 Washington Navels, and trees from ten to twenty years so laden that their branches were bent to almost breaking point. This, I may add, in an orchard that by previous owners had been sadly neglected and even now was suffering from a dirty tilth and careless irrigation.

I naturally did not expect to find mosquitoes at the time of year my visit was made, nor did I, but I was informed that undoubtedly during the wet season a few cases of malaria did occur amongst those who failed to take the ordinary precautions against infection or slept without curtains. The class of infection I judge to be principally a mild benign tertian and I cannot see that the danger of infection is as great as we encounter daily in nine-tenths of the stations which in India are regarded as healthy; furthermore, the Company have already taken steps under the personal recommendation of Dr. Orenstein, late of the Panama Canal Malaria Commission, to clear out spruits, drain low-lying land and plant blue gum trees in order that such malaria as now exists should be completely eradicated. No great work is required, no mosquitoes can breed in the clean cut conduits and canals that lead abundant water in all directions over the Estate, and as all irrigation channels amongst the trees are opened and filled in again within the space of twenty-four hours, no danger can arise from routine working, in fact the management confidently expect that by next year malaria will cease to exist within the confines of their property, and I am optimistic enough to agree with them, but in my opinion it would be as well for intending settlers to postpone taking up permanent residence until such time as the estate is in a producing stage, say five years from date.

The climate during my stay was perfect, cool nights making a blanket or even two, if sleeping on the verandah, desirable. The rains fall during the hot months, November, December and January, when temperatures of almost 100° F. are registered, but the nights are cool, and I was unable to obtain any information about "prickly heat" as no one knew what I meant.

The Company are making quite serviceable bricks out of ant-heaps, which can be purchased for £1 per 1,000, labour is cheap, and if one used local timber an estimate for a really fine spacious bungalow with a fourteen-foot verandah and

kitchen and out offices of substantial nature comes to £800 to £1,000 ; of course, if expensive doors, windows and bathroom fittings are purchased, any sum may be expended.

As, before arrival in the country, my ideas regarding distances, travelling expenses, etc., were vague in the extreme, I give here a few particulars on these points :—

Passage to Durban by Natal Line (one class only) ...	£52 10 0
Rail Durban to Johannesburg	4 16 0
Johannesburg to Pietersburg	2 6 0
Johannesburg to Capetown	9 0 0

There is excellent accommodation on trains. On each occasion I was given without any trouble a coupé to myself, the dining car on all mail trains is quite good and reasonable—3s. 6d. breakfast and lunch, 4s. dinner.

I had to pay rather heavily for excess baggage as I had much more than I really needed. Ordinary light summer-weight tweed suits are worn and in the hot season silk and linen. Some men wear pith topees, but I never felt the need and wore an ordinary Homburg all through. Hotel charges are from 17s. to £1 per day inclusive, but such is the hospitality of the country that although I started comparatively friendless, I was put up at the best clubs everywhere I stayed at a most reasonable rate.

Now as regards the crux of the whole position apart from the desirability of South Africa as a place of residence for poor pensioned officers. Will citrus farming pay? It most certainly pays at present and the industry is most confident that the market can be expanded indefinitely—within the last month a most important development has taken place in the formation of a Fruit Growers' Exchange, which will be working on co-operative lines and control the selection, export and selling of citrus fruits and reduce all overhead charges.

There is no fortune to be made at general farming I am convinced. A boy, after four years' practical work on a farm and at an agricultural college should be able to earn a livelihood either as a manager or by leasing a farm and slowly getting together a herd, but without several thousand pounds and a reserve to tide over a bad season or two, it is slow and very hard work. Many men have come to grief during the present slump, who owing to starting on borrowed capital have been sold up by the banks and bond-holders for want of such a reserve. A small pension of even £200 a year is an enormous asset.

At the present time all branches of farming are at a low ebb. Stock is unsalable, the drought which seems almost universal will bring many tottering concerns into the bankruptcy court, and the revolt on the Rand has had a far-reaching effect. Now, no doubt, is the time for a man with some ready money and experience to purchase and stock a farm, but without the experience and farming knowledge he will surely lose his money.

I am informed that the Letaba Estate has no more land to sell at present. There are many other more or less similar properties on the market ; a personal visit before purchase is most advisable, and will be a couple of hundred pounds well invested.

That individual owners of ten acres more or less of orange groves will be able to work, pick and market their fruit is I consider quite impossible as an economic

proposition. A large estate split up into plots will have to work as a co-operative society, each plot-holder having shares in proportion to his holding ; a resident Board of Directors to guard their interests, with a technical skilled staff performing the highly specialized work of cultivation and gathering, will be required—and once the fruit is handed over to the District Exchange of the Fruit Growers' Association, the transport and marketing is provided for. The importance to the industry of this newly-formed Exchange cannot be overstated—it will be in a position to secure adequate shipping accommodation, open up new markets and control shipments so that the chaos and delays now of weekly occurrence will be obviated, and a regular supply of properly graded fruit of high quality only will be offered for sale on the European markets.

On reading over this letter I am struck with its optimistic tone and fear that as regards the particular Estate I visited I may be considered prejudiced in its favour. So far from this being the case, I went up there prepared to throw over the whole scheme, forfeit the payments I had made if necessary, and clear out, cutting my loss. A personal visit to the property and acquaintance with the financiers responsible to the plot-holders for the successful launching of the venture inspired the opinion I herewith express.

Thymira,

Tecthery,

August 2, 1922,

I am, etc.,

H. CARR,

Major-General, R.P.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

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Journal
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Original Communications.

SOME OBSERVATIONS ON THE OCCURRENCE OF *LEISHMANIA*
IN THE INTESTINAL TISSUES IN INDIAN KALA-AZAR,
ON THE PATHOLOGICAL CHANGES OCCASIONED BY
THEIR PRESENCE, AND ON THEIR POSSIBLE SIGNIFI-
CANCE IN THIS SITUATION.

BY BREVET LIEUTENANT-COLONEL H. MARRIAN PERRY.
Royal Army Medical Corps.

SINCE the discovery by Leishman, in 1900, of the causal organism of Indian kala-azar, the cutaneous and visceral infections caused by these parasites have attracted considerable interest, and there are few diseases of warm climates around which such a large literature has accumulated.

Notwithstanding the widespread research into the possible methods of transmission of the visceral form of the disease, we are still without information regarding the means of its transference from man to man. There are, however, other aspects of this infection on which more exact information is available. The pathological changes encountered in fatal cases of visceral leishmaniasis are now well recognized, and the situation and distribution of the parasites in the tissues have been more or less defined. In any consideration of the pathology of the disease, it is evident that the most predominant feature is the early increase in size of the liver, and more particularly of the spleen. The great enlargement of the latter organ resulting from an increase in the splenic pulp is caused by the enormous proliferation of lymphatic and vascular endothelium. The distribution of the leishmania bodies is typically as intracellular parasites of these hypertrophied endothelial cells, and, although occurring in largest numbers in the spleen, liver and bone marrow, these protozoal organisms have

been demonstrated in almost every other tissue of the body. They are fairly abundant in the bone marrow, and have also been observed in smaller numbers in the kidneys, the suprarenals and in the pancreas. It is a matter of comment that less attention appears to have been directed to the distribution of the parasites in the gastro-intestinal system, and to the changes resulting from their presence in this situation.

In reviewing the literature dealing with this aspect of the pathology of the infection, it is noted that most of the observations appear to have been directed to the gross lesions which are found in the large intestine in many cases of the disease. Christophers [1] comments on the fact that it is common in India to find a widespread multiple ulceration in this part of the bowel, the ulceration extending deeply into the muscular coat of the intestine. In some of his cases amœbæ have been found in the ulcers and associated liver abscess has been present, evidently coincident infections with *Entamœba histolytica*. Jemma and Di Christina [2] note the constant occurrence of an enterocolitis in cases of infantile kala-azar, and the presence in the large intestine of circular ulcers with elevated edges. These latter observers have further found on microscopic examination that these lesions were associated with a small round-celled infiltration of the mucosa and muscular coat, together with dilatation of the lymphatic vessels and hypertrophy of the endothelium in which leishmania parasites were sometimes present. Christophers also records the presence of *Leishmania* as intracellular parasites of endothelial cells lining the blood-vessels in the granulation tissue of ulcers in the large intestine, whilst Archibald [3], writing on the pathology of the infection, states that in his experience of the visceral form of the disease the stomach and small intestine are not commonly affected, but that the large intestine may show congested and ulcerated areas in the greater part of its length.

In this brief review of the pathology of the disease as it affects the gastro-intestinal system, it will be noted that no observations are recorded relative to changes in the small intestine. It is in connexion with certain microscopic appearances seen in this portion of the intestinal tract in two fatal cases of the Indian variety of the disease that this communication is made.

The material available for investigation, and on which the observations that follow are based, consisted of small portions of the jejunum, which, as far as macroscopic appearances are concerned, would not have been considered abnormal at post-mortem examination. On closer investigation the mucosa could be seen to be slightly thickened, the other coats of the intestine being normal in appearance. No evident breach of surface or ulceration was apparent in the mucous coat of the portions of tissue examined. The microscopic investigation of sections made from various parts of these tissues, stained by Wolbach's modification of Giemsa's method, demonstrated a very consistent and interesting pathological picture. The changes observed can be shortly summarized as follows:—

The histological appearance of the serous, muscular and submucous coats differed in no detail from that normally seen in the small intestine. The most striking change was that evident in the mucous membrane owing to a very definite and remarkable alteration in the villi. These processes of mucous membrane had undergone a complete metamorphosis, and, instead of appearing as slender narrow fimbria as seen in the normal intestine, each villus appeared as a swollen, distorted and polypoid body connected with the submucous tissue by a constricted stalk formed of a few fibres of connective tissue. The columnar epithelium covering the villi had disappeared and the basement membrane furnished a delicate limiting sheath for each little swelling. The internal structure of the villi was completely altered owing to an intense proliferation of the endothelial cells lining the lymph channels. This proliferation of endothelium, although marked in the base of the villi, became more pronounced towards the centre and extremities of these structures, and the enlargement and distortion was caused by these tightly packed accumulations of hypertrophied cells. In the greater number of villi the basement membrane was intact, but in many instances it had ruptured from over-distension and liberated the enclosed endothelial cells.

The distribution of leishmania bodies in the intestine was very striking. They could be demonstrated in scanty numbers in the submucous coat, in which position they occurred in endothelial cells evidently derived from vascular endothelium. They were present in larger numbers, in the same intracellular situation, in the base of the villi. In the centre of the villi they had undergone rapid multiplication, and they were present in enormous numbers in the endothelial cells distending the extremities of these structures. In many of the villi numbers of endothelial cells had broken down, and the parasites were lying, mixed with the debris of necrotic cells, free in the villus. Reference to the figures illustrating the changes observed will enable the striking alteration in appearance of the villi to be appreciated. The writer has had the opportunity of examining spleen and liver sections from a large number of cases of visceral leishmaniasis, and has not in any case observed an infection of endothelial cells which would compare numerically with the great numbers of parasites present in these endothelial villous tumours.

A comparison of the cellular reaction observed in the small intestine in these cases of visceral infection with that evident in the subcutaneous tissues in cutaneous leishmaniasis illustrates the close analogy between the two conditions.

In both infections the type of cell involved is the lymphatic and vascular endothelium and any difference observed depends entirely on the localization of the parasites. In the visceral disease, at least as far as the above cases are concerned, the intestinal villi were heavily infected, and the resulting endothelial proliferation had formed a series of endothelial villous tumours. In the cutaneous form of the disease, an Oriental sore is

at its inception nothing more than a subcutaneous endothelial tumour. The continued accumulation of endothelial cells, either in the villi or in the subcutaneous tissues, eventually leads by mechanical pressure to a deficiency or obliteration of the blood supply and consequent atrophy and necrosis of these cells which finally terminates in ulceration.

DISCUSSION ON THE POSSIBLE RELATION THE ABOVE OBSERVATIONS MAY HAVE ON CERTAIN FEATURES OF INDIAN KALA-AZAR.

(1) *On the Clinical Course and Symptoms of the Disease.*

In any clinical description of the disease the progressive wasting and finally extreme emaciation which occurs in the established infection is emphasized. Thus, in compiling a table illustrating the differential diagnosis between Indian kala-azar and chronic malaria, Knowles notes that in kala-azar emaciation is very marked and sometimes extreme, whilst in chronic malaria it is less noticeable. Further, the constant recurrence of symptoms referable to the intestinal tract, such as enteritis, are very commonly observed during the course of the disease.

That progressive and extreme emaciation should be a common feature in the clinical picture is not surprising if the pathological changes in the small intestine described above can be shown to be usually present.

It is obvious that the profound alteration of the intestinal villi must almost arrest, or at least considerably reduce, the absorption of nutritive substances. The destruction of the epithelial covering of the villi combined with the vascular and lymphatic stasis caused by the pressure of accumulated endothelial cells in their interior must produce a complete perversion of their normal physiological function and render them useless for purposes of nutrition. In a similar manner it is possible that the recurrent attacks of diarrhoea, so typical during the disease, may find their explanation in this alteration in structure of the mucous lining of the bowel.

(2) *On Methods of Transmission of the Disease.*

In discussing the relationship which the above observations on the distribution of leishmania parasites in the tissues of the small intestine, might be conjectured to have on the problem of transmission of the disease, the writer does not wish it to be assumed that he favours the theory of infection of the human subject by the alimentary route. The knowledge that the causal parasite of kala-azar is a flagellate included in the genus *Herpetomonas*, and that the known species of this genus find their primary habitat in the intestinal tract of an insect host, is a very strong argument against the direct transmission of the organism through the agency of infected faecal material. Admittedly, however, there are only two possible routes by which the parasites can escape from the human tissues, i.e., either from the peripheral blood, through the agency of some blood-sucking ecto-parasite, or from the alimentary canal in the faeces.

The researches undertaken with the view of the incrimination of an intermediate insect host are ably discussed by Patton [4], who is strongly in favour of this method of transmission of the disease. He cites numerous experiments illustrating the longevity and development of the parasites in the intestinal canal of bugs belonging to the genus *Cimex*, and quotes the developmental changes observed by Cornwall in preparations containing the flagellate stage of the parasite and portions of the mucous membrane of the stomach of *Cimex rotundatis* (hemiptera) "as furnishing final proof that *Cimex* is the true intervertebrate host of *H. donovani*."

The recent work of Helen Adie [5] in India on the development of flagellates in the cells of the mid-gut of *Cimex hemiptera* which had been fed on infected splenic pulp have been criticized by Wenyon [6] on the grounds that these observations had been made on bugs which had died after the infecting feed and had not been examined until after the lapse of some days. The further observations of this worker on the presence and multiplication of the parasites in the salivary glands of *Cimex* has not been accepted, the bodies observed being neither *Leishmania* nor a developmental phase of some other flagellate.

The possibility of the dissemination of infection by mosquitoes, sand flies, lice and ticks has been closely investigated by many observers, but has up to the present yielded negative results.

The fact, however, that viable forms of the parasite can be shown by cultivation to occur in the peripheral blood, and that the incidence of the organisms in this situation is very much higher than one had formerly believed, favours the view that infection is probably spread from this source by some insect host. Thus, Patton states that it was the exception to fail in finding parasites in the peripheral blood of his cases in Madras, and Knowles [7] records the presence of *Leishmania* in blood films in forty-five per cent of the cases under his investigation in Shillong.

The present position regarding the problem of transmission of infection through the intermediary of an insect host can be summarized by the statement that no conclusive evidence is at the moment forthcoming which would incriminate any of the above agents.

The second possible method of elimination of the parasite from the human body being by the faeces, the possibility of direct faecal transmission of the disease from infected cases to healthy human subjects has received some consideration and support. Knowles, in discussing this aspect of the problem, cites the case of a municipal sweeper in Nowgong whose only apparent contact with infection was in connexion with his conservancy duties. The same observer figures small oval cytoplasmic bodies found in the dysenteric mucus of several cases of kala-azar suffering from intestinal symptoms, but could not reconcile their nature with any known form of the parasite. Mackie [8] also noted and recorded the presence in faecal mucus of small cytoplasmic bodies with a chromatin nuclear structure which he considered indistinguishable from *Leishmania*; and Minchin, to whom the

preparations were submitted, expressed the opinion that they resembled *Leishmania*. To obtain a series of controls, Mackie examined the fæces of twenty-six healthy individuals living in the same area as the kala-azar cases in which the presence of these puzzling "bodies" was observed. In none of these individuals could he demonstrate structures of similar appearance. A limited number of feeding experiments, employing dogs and monkeys, with mucus containing these bodies, was undertaken, but yielded negative results. Patton, on repeated examinations, has failed to find any bodies of the nature of *Leishmania* in the fæces, and concludes that if the parasites appear in the excreta they do not occur in their usual round or oval form. Both Knowles and Patton have failed to obtain any evidence of development in cultures made from intestinal mucus. This latter fact is, however, of little importance owing to the impossibility of obtaining cultures uncontaminated with bacteria.

Feeding experiments with intestinal mucus from infected cases have failed, as noted above, to give positive results, but Archibald and others have recently been successful in infecting monkeys by feeding them on infected splenic pulp.

The possibility of dissemination of the parasites by a helminthic agency has been investigated, but has failed to help in the elucidation of the problem.

The above very limited survey of the painstaking research work carried out on the transmission of kala-azar has been given to emphasize the fact that the problem of the method of spread of this disease still awaits solution, and that any fresh observations relative to the pathology of the infection are deserving of consideration.

In an earlier part of this paper it has been recorded, in describing the pathological appearances observed in the small intestine in two cases of the disease, that the localization of the parasites was mainly in the intestinal villi, and that there was evidence of intense multiplication in this situation leading to an enormous increase in their numbers in the extremities of these structures (fig. 2). The delicate nature of the sheath enclosing these little swollen processes of mucous membrane was mentioned, and the fact that in many of them this had ruptured and liberated the enclosed parasites and endothelial cells into the lumen of the intestine (fig. 3). It is possible, and indeed even probable, that in many instances this rupture of the villi had occurred in the preparation of the sections, but there is little doubt from the swollen and distended appearance of the majority of these processes that over distension of the limiting membrane was sufficient to cause rupture during life. It is evident, therefore, that myriads of leishmania parasites must have been liberated into the intestinal contents during the course of the disease, and it is interesting to conjecture as to the possibility of their survival in the fæces.

The fact that the flagellate stage of the organism is incapable of living for any length of time in cultures which have been contaminated by

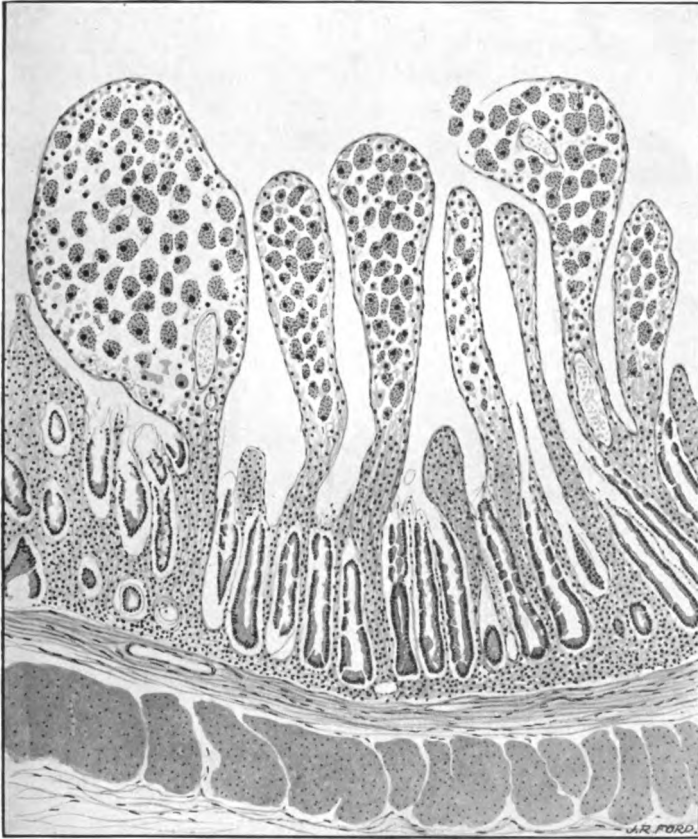


FIG. 1.—Section of intestine showing distortion and hypertrophy of villi filled with proliferated endothelial cells containing *Leishmania*. Camera lucida tracing X 100.

To illustrate "Some Observations on the occurrence of *Leishmania* in the Intestinal Tissues in Indian Kala-azar, on the Pathological Changes occasioned by their presence, and on their Possible Significance in this Situation," by Brevet Lieutenant-Colonel H. MARRIAN PERRY, R.A.M.C.

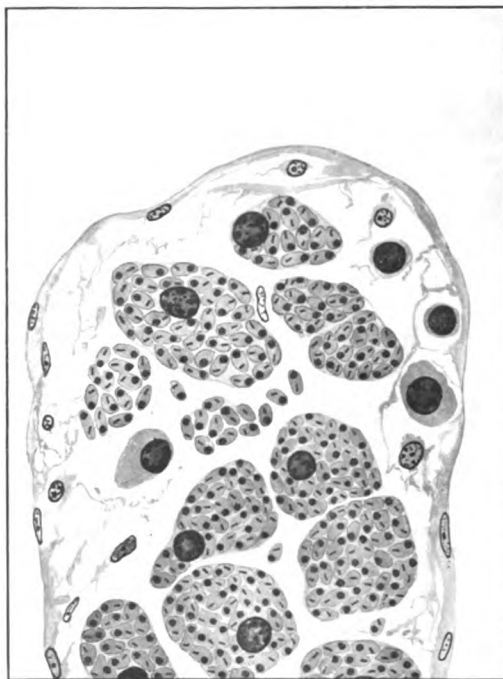


FIG. 2.

FIG. 2.—Section of villus showing intracellular and free *Leishmania*. Basement membrane still intact. Semi-diagrammatic.

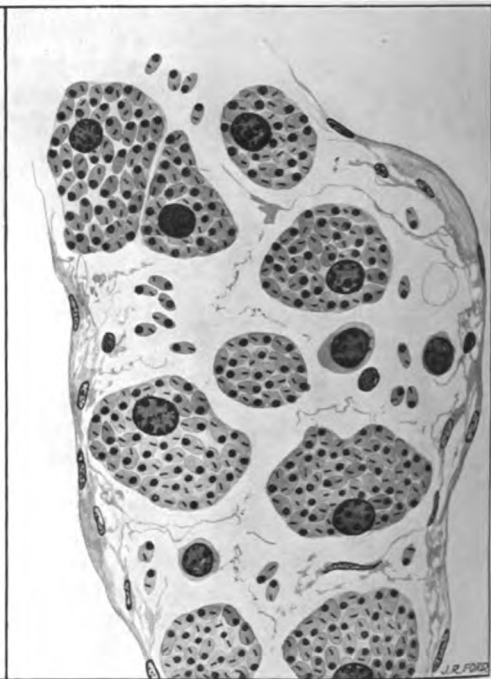


FIG. 3.

FIG. 3.—Section of villus showing ruptured basement membrane and escaping endothelial cells and parasites. Semi-diagrammatic.

To illustrate "Some Observations on the occurrence of *Leishmania* in the Intestinal Tissues in Indian Kala-azar, on the Pathological Changes occasioned by their presence, and on their Possible Significance in this Situation," by Brevet Lieutenant-Colonel H. MARRIAN-PERRY, R.A.M.C.

bacteria is against the presumption of the continued viability of the parasite in faecal material in this phase of its development. Is it possible that some hitherto undescribed encysted form is developed in the faeces? The contaminative cycle of development of the various species of *Herpetomonas* of insects, to which attention has often been directed in this connexion, is a tempting analogy. Again, if the parasite in some resistant form can withstand the inimical nature of its surroundings in the faeces, have the possibilities of its ingestion by some faecal feeding insect been exhausted?

Further research alone can decide whether the insect-borne or alimentary theory will prove to be correct in defining the exact ætiology of the disease, but the fact that, in at least some cases of kala-azar, there occurs an intense elimination of parasites into the intestinal canal may stimulate renewed research into every possible method of dissemination of infection through the medium of infected faeces. In this connexion, the summing up of Knowles on this aspect of the question may be quoted: "This possibility (i.e., faecal transmission) deserves, perhaps, more careful consideration than it has hitherto received. In Assam, at least, the distribution and incidence of kala-azar is closely associated with insanitary surroundings and an absence of all conservancy methods."

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A ROYAL ARMY MEDICAL CORPS STAFF TOUR IN EGYPT.

BY BREVET-COLONEL H. ENSOR, C.M.G., D.S.O.

Royal Army Medical Corps.

THIS staff tour was held on February 6 and 7, 1922, as part of the winter training of Officers, R.A.M.C., serving in Egypt.

It was specially designed to make officers familiar with the French method of identification of points on a map, which is now the only one officially in use in the British Army.

It is so important for all our officers to be familiar with this method, that the explanation of it published by the General Staff in August, 1918, is reproduced here.

IDENTIFICATION OF POINTS ON A MAP.

EXPLANATION OF THE FRENCH METHOD.

Issued by the General Staff, August, 1918.

1. Imagine a map in one huge sheet covering the whole area of operations. Take any point in this map as origin and draw two lines through it at right angles. These lines are called the axes. Draw a series of lines at intervals of one kilometre parallel to these axes.

The whole map is then covered with a grid of kilometre squares, and a point is identified by giving its distance in metres east and north of the origin. For the sake of convenience the origin is selected so that every point in the theatre of operations must be east and north, and the necessity of adding north, south, east or west to the figures is avoided.

On the published maps the actual distance of every grid line from the origin is given in metres, and the co-ordinates of the south-west corner of the square in which lies the point to be identified can be at once read off. To these must be added the co-ordinates of the point in metres from the south-west corner of the square reading the horizontal distance first, and then the vertical in the same way as in the English system.

Its advantages are that it is easy to calculate the range and bearing between any two points whose co-ordinates are known, and it is independent of sheet lines. It is not even necessary that the sheet lines should be parallel to the grid. The whole map can be cut up into sheets of any size, and lying at any desired angle.

As a matter of fact the sheet lines of the French maps are not parallel to the grid, and in the English system of maps they may not be parallel either. This makes no difference whatever to the use of the grid.

It should be understood that the vertical grid lines do not run true north and south. It is convenient, however, for practical purposes to treat them as north and south lines, and this is always done, the term Grid

North being used, and all bearings being given with reference to the Grid North.

2. The following description will be printed on each map until the new system is quite familiar :—

(1) The sides of the squares on this map are one kilometre (1,000 metres) in length.

(2) Each square is known by a number, which represents the co-ordinates (or distances) of its south-west corner in kilometres east and north of the origin. Thus 58 (short for 175.308).

If it is intended to refer to the point which is the south-west corner of a square as apart from the square itself, the correct co-ordinates are 50.80.

(3) To describe roughly the location of a point within the square, consider the sides divided into ten parts, and measure the tenths east and north of the south-west corner. Thus the point A is 5384, and is thus placed to the nearest 100 metres. (In reports this should be written 5.3—8.4).

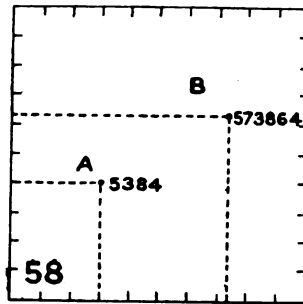


FIG. 1.

(4) To define a point more accurately to within ten metres, consider the sides divided into 100 parts and measure the hundredths east and north. The point B is thus 5.73—8.64. This is called a "pinpoint" reference. It should never be used when transmitting a point to the French, who use only the four-figure system.

(5) It is usually evident which kilometre square is meant. In order to avoid ambiguity, letters have been given to each square of ten kilometre side, and in cases of doubt this letter should be given also, thus for point A the co-ordinates are P 5.3—8.4.

3. This description is here expanded. The co-ordinates, or distance from the origin of each kilometre line, are printed on the margin of the map, but only every tenth co-ordinate is printed in full. The first two figures remain constant for a distance of ten kilometres, and within that limit a square is completely identified by the third figures, which are the co-ordinates of its south-west corner in kilometres within the ten-kilometre square.

The diagram, fig. 2, which is a ten-kilometre square on a small scale, makes this plain. The numbers identifying the kilometre squares have only been inserted in a few squares, but on the map they are printed on every square in order that it may be possible to identify them without reference to the margins.

In the square 58, fig. 1, the reference to point A is 53.84, which means that it is 175300 metres east and 308400 north of the origin.

Similarly point B is 175730 metres east and 308640 metres north.

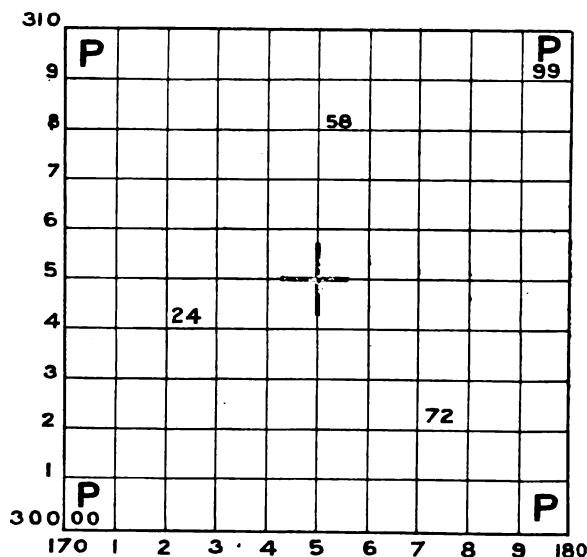


FIG. 2.

In each case the first two figures, 17 and 30, are omitted, but the letter, in this case P, can be given if there is any chance of the receiver of the message mistaking the point for a point ten kilometres away possessing the same abbreviated co-ordinates. It is much simpler to transmit a letter than the co-ordinates in full.

The centre of the ten-kilometre square will be defined by thickening the centre lines for a short distance as shown. This divides the ten-kilometre square into four parts, known as *a* (north-west), *b* (north-east), *c* (south-west), *d* (south-east). These are for the purpose of artillery zone calls only, and these letters should not be used in any map reference.

If an object is stated to be at a point, the co-ordinates of which are given to four figures, e.g., 53.84, it means that the object is known to be within a square of 100 metres side, of which the point 53.84 is the centre. Similarly the point 573.864 is the centre of a square of ten metre side.

It is important to realize that two figures, e.g., 58, although they

actually are the co-ordinates of the south-west corner of the square, always apply to the square itself. A point must not be defined by less than four figures, and if it is intended to locate an object at the corner of a square the co-ordinates must be given in four figures, thus 50.80.

It is pointed out that the use of a grid of kilometre squares in no way interferes with the use of a scale of yards for ordinary purposes.

Twenty-six officers, R.A.M.C., and I.M.S., not counting the Director (Colonel H. Ensor), attended the staff tour.

The place of rendezvous for the officers was the bridge over the Taufiqiya canal at D 43—73 at 08.30 hours. On the first day of arrival at the rendezvous a copy of "Z" Division, Order No 1, and position of divisional artillery, which had been written by the Director, was given to each officer and all field officers and officers of ten years service were instructed to reconnoitre the ground and write the R.A.M.C., order for the forthcoming battle, as officer commanding, R.A.M.C., "Z" Division.

Each officer had already been for some days in possession of the general and special idea and had written an appreciation of the medical situation from the point of view of the D.M.S. Army.

Orders were given to them by the Director that the R.A.M.C. orders of these officers were to be completed and handed in to him at the rendezvous at 16.30 hours the same day.

All officers of less than ten years' service were detailed to act as regimental medical officers to the battalions of "Z" Division and were then instructed to proceed to the position which would be occupied by these battalions before zero hour and, on arrival, to select sites for their regimental aid posts.

At noon they were to report at the rendezvous to the Director when a conference would be held.

At this conference the duties of regimental medical officers in action were very thoroughly discussed.

In the afternoon the Director, assisted by Captain H. G. Winter, M.C., R.A.M.C., gave instructions in map reading to the junior officers, and the taking of bearings, their correction for variation and the laying off of bearings on a map, resection, etc., were thoroughly explained.

The Director had previously, as part of the winter training, given two lectures at the R.A.M.C. Mess, at the Citadel, Cairo, on this most important subject, i.e., map reading.

At 16.30 hours the senior officers handed in their "Z" Division R.A.M.C. orders for the battle on the following day and a copy of "Z" Division R.A.M.C., Order No. 1, written by the Director, was then given to each officer and orders issued for them to assemble at 08.30 hours at the same place on the following day.

On the next day, February 7, at the rendezvous a copy of narrative No. 1 was given out to each officer and the medical arrangements to be

made by A.D.M.S., "Z" Division, to meet the needs of the military situation were thoroughly discussed.

At the end of the discussion a copy of the Directors' views as to what arrangements should be made was given to each officer.

The narrative No. 2, and so on, were issued and the actual places where the imaginary fighting was going on were visited and full discussion took place on each narrative before the medical arrangements made out by the Director were issued.

Full discussion was permitted to every officer but of course the decision of the Director was taken as final with regard to any debatable point.

The R.A.M.C. training was closely followed by the Director and such suggestions as the amalgamation of all three Bearer Divisions of "Z" Division for duty in clearing wounded and other similar suggestions founded on experience in trench warfare in France were ruled out.

It was impressed on every officer at the beginning of the staff tour that the fighting which was to take place was to be of the nature of open warfare.

The staff tour was voted by everyone who took part in it to be a success from every point of view, and it most certainly was thoroughly enjoyable.

The thanks of all who took part in it were due to Major L. V. Thurston, D.S.O., R.A.M.C., and the officers of the British Cavalry Field Ambulance, stationed at Helmeih Camp, for their kindness in providing transport to take the officers from point to point and also for their hospitality.

It may be added that not a single officer who presented himself for examination in C ii, for promotion to Major, failed in his examination early in April this year.

R.A.M.C. STAFF TOUR.

GENERAL IDEA.

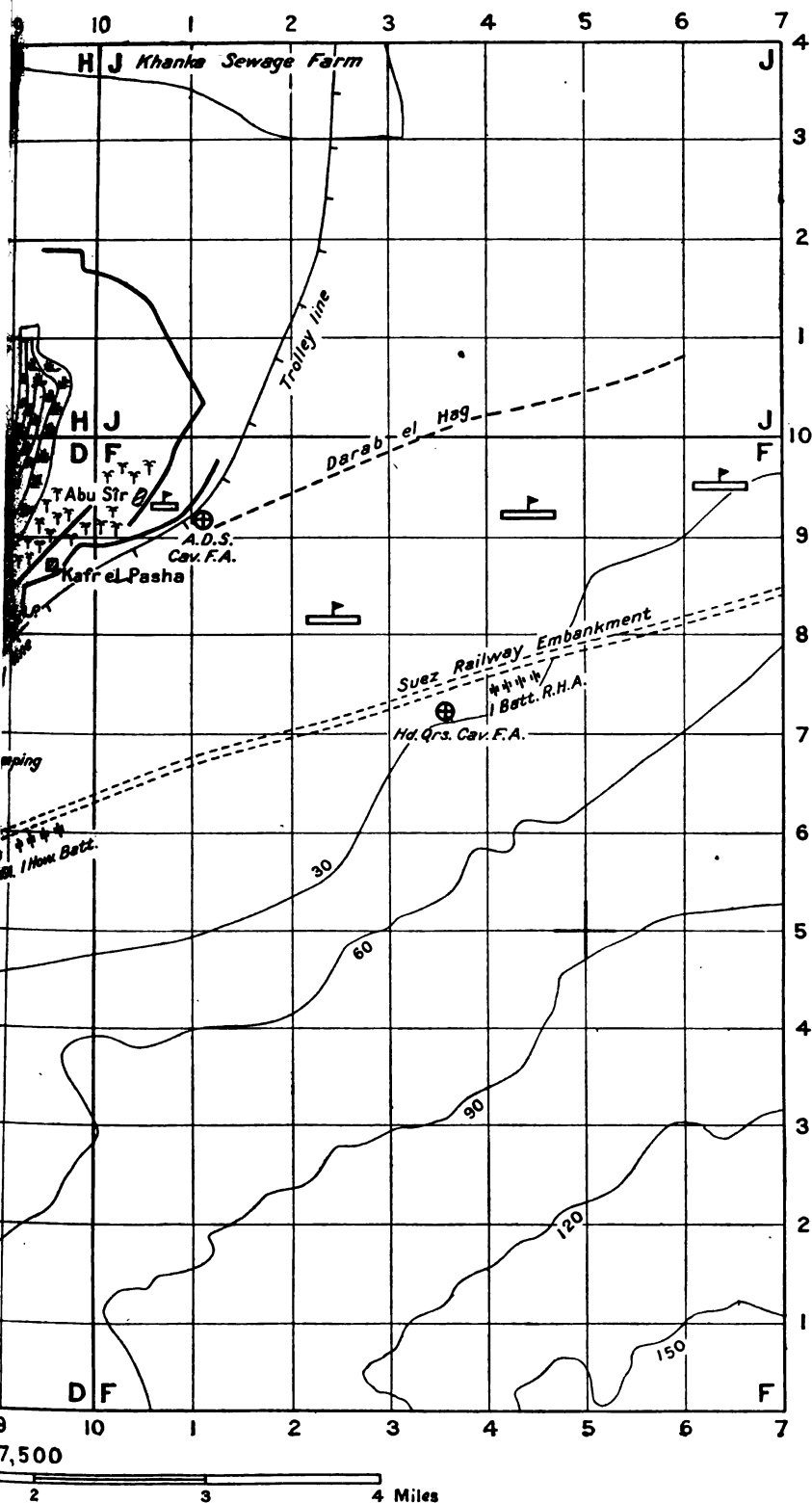
Reference: Manœuvre Map of Desert, East of Heliopolis, 1:40,000.

(1) An enemy army has occupied the Suez Canal, and has formed its advanced base at Ismailia, from whence an army corps of three divisions and a cavalry division has been dispatched to attempt to capture Cairo. The enemy commander expects to be in a position to reinforce this army corps with another of the same strength in a few days.

(2) The defending army, to which we shall consider ourselves to belong, consists of a cavalry division and two army corps, each of three divisions.

(3) The headquarters of this army is at Helouan and also the headquarters of one army corps. The headquarters of the other army corps is at Cairo and two of its divisions together with the cavalry division are engaged in meeting the attack on Cairo.

The third division has been kept in reserve at Abbassiya. This division will be known hereafter as "Z" Division.



Units of "Z" Division and the Regiments, Artillery and Medical Units
ur, February 7, 1922.

- Regimental Aid Post +
- Advanced Dressing Station ⊕
- Divisional Walking Wounded Collecting Post +
- Car Post *
- Headquarters Divisional Motor Ambulance Convoy ☒
- Divisional Main Dressing Station ■

(4) After three days' heavy fighting along both sides of the Ismailia Canal, the two defending divisions with the cavalry division have been slowly pushed back, until at 06.00 hours on February 6 (sixth), the situation is as follows:—

One enemy division has succeeded in reaching a line drawn from D 1.5—8.5 to south end of village of El Marg and from thence eastwards to El Birka, D 8.3—8.1. Its right flank is thus on the Ismailia canal and its left is covered by the swamp shown in square D 89 and 99, and H 90. Its left flank is protected also by a cavalry force estimated at about two regiments.

The two other enemy divisions have also succeeded in approaching Cairo and are in a line west of the Ismailia canal.

(5) As a result of heavy fighting and very severe casualties, the enemy divisions are believed to be much exhausted.

(6) The defending army to which we belong has, up to the present, only employed two divisions in the defence, which are, however, now both exhausted as a result of the three days' heavy fighting.

The cavalry division has also been employed, but has suffered comparatively few casualties in men and horses, and is in no way exhausted.

(7) Two divisions from the army corps at Helouan have arrived as reinforcements and these two divisions, together with "Z" Division, have relieved our two exhausted divisions.

(8) Early in the day (February 6) the enemy showed a disposition to occupy the line of the El Taufiqiya canal, but was easily repulsed.

Air reconnaissances made later in the day reported that the enemy was busily engaged in fortifying the villages of El Khusus, D 2.8—9.4, El Marg, El Birka and El Qalag.

(9) The divisions of the defending army are to be considered as provided with field medical units on the scale laid down in the Field Service Pocket Book, 1914, and that line of communication medical units have been mobilized on the scale given in R.A.M.C. Training.

(10) The inhabitants of Egypt are to be considered as not very hostile to the invading army.

SPECIAL IDEA.

(1) The enemy can now be considered to have failed in his attack on Cairo and the initiative to have passed to the defending forces.

An Indian force has landed at Suez and taken that town and so caused a diversion which will prevent the enemy from reinforcing his army corps, dispatched to attempt the capture of Cairo, for some days.

(2) In consequence, it is the intention of our army commander to attack the enemy at once and, if possible, to destroy his forces before they can be reinforced. It is to be assumed that the necessary orders have been issued by Army Headquarters to this effect.

(3) It is now to be assumed that "Z" Division is to be the division to

which we belong and that it is in position opposed to the enemy division which has taken up the line given in para. 5 of the General Idea.

The outpost line taken up by "Z" Division is the following:—

D 1.0—7.5 eastwards to railway at D 4.6—7.5, from thence eastwards north of village of Kafr el Shurafi el Sharqi at D 6.8—7.4, to the Taufiqiya Canal at D 7.8—7.5; thence north of canal to north of Kafr el Pasha at D 9.5—8.7.

A brigade of cavalry is to be assumed as covering the right flank of "Z" Division. This brigade comes directly under corps headquarters for orders.

(4) The medical arrangements to be made for "Z" Division and the cavalry brigade preparatory to and during the attack on the enemy division to which it is opposed, will be gone into in detail.

(5) Operation Order No. 1 issued by General Officer commanding "Z" Division has been issued to all concerned and is attached.

(6) Medical arrangements issued by D.D.M.S., Army Corps, are also attached.

(7) For the purposes of this staff tour it is to be assumed that neither of the opposing armies is in possession of any artillery other than that laid down in the Field Service Pocket Book, 1914, for Cavalry and Infantry Divisions. Both armies are, however, strong in air forces.

The composition of "Z" Division and of the cavalry brigade is also to be that given in the Field Service Pocket Book.

The Field Ambulances are to be assumed to be equipped with motor ambulance transport.

SECRET.

"Z" DIVISION ORDER NO. 1.

Reference: Manœuvre Map of Desert east of Heliopolis.

February 6, 1922.

(1) Enemy forces estimated at a division are in occupation of the villages of El Khusus, D 2.8—9.4, El Marg, D 58, and El Birka, D 88.

A cavalry force of about two regiments is covering the enemy's left flank. It is reported that the enemy have since early this morning been engaged in preparing the above-mentioned villages for defence.

(2) The division will attack the enemy to-morrow, February 7, at zero hour. The two divisions of our army corps opposed to the enemy west of Ismailia Canal will attack the enemy at the same hour.

A cavalry brigade will co-operate on the right flank with the attack of "Z" Division.

(3) "A" infantry brigade will carry out the attack on El Khusus with two battalions, with one battalion acting in support.

"B" infantry brigade will attack El Marg; one battalion attacking on the west and two attacking to the east of the railway line.

"C" infantry brigade will assault the village of El Birka with two

battalions, one battalion remaining in reserve in the cutting of the El Gebal Canal.

The infantry battalions ordered to make the attack on the enemy positions will be drawn up on our outpost lines by 04.30 hours to-morrow morning, February 7.

(4) The colonels commandant of each infantry brigade will detail one battalion to report to Lieutenant-Colonel "Y" on the road due east of Ain Shams railway station at 03.00 hours to-morrow, February 7.

These three battalions will form the divisional reserve and will at 03.00 hours come under the command of Lieutenant-Colonel "Y."

By 04.30 hours to-morrow, February 7, these battalions are to be in position in the cutting of the El Gebal Canal from D 4.0—6.2 to D 6.9—6.8.

(5) The C.R.A. will issue the necessary orders with regard to the artillery support of the attack.

(6) The C.R.E. will arrange for crossings to be made over the mud in the El Taufiqiya Canal at intervals of 500 yards, from D 2.4—7.0 to D 9.0—8.4; work not to be commenced before nightfall to-day.

(7) The A.D.M.S. will issue the necessary orders with the regard to the medical arrangements to all concerned.

(8) Divisional advanced headquarters will open at 03.00 hours to-morrow, February 7, at Matariya in house on road at D 2.7—5.0.

Messages and reports will be sent there after 03.00 hours to-morrow.

Rear headquarters will remain at Abbassiya at A 0.6—8.6.

(9) Zero hour will be communicated to all concerned later.

(10) Acknowledge.

Colonel.

G.S., "Z" Division.

Copy No. 1. Headquarters, I Corps.

Issued at 10.00 hours by

" " 2.

Signal Coy., Dispatch Riders.

" " 3.

" " 4.

" " 5.

" " 6.

" " 7. A.D.M.S.

(etc.)

POSITION OF DIVISIONAL ARTILLERY.

The following may be considered as the position of divisional artillery at the commencement of the attack:—

F

R.H.A.

(1 bde.) (18 prs.). Behind the embankment of the old Suez railway in D 85 and D 95 (1 howitzer battery) (4.5).

Brigade headquarters and 1 howitzer battery (4.5), behind the embankment of old Suez railway in D 64.

- 1 bde. (18 prs.) behind the village of El Gamus in D 55.
- 1 bde. (18 prs.) west of the village of Arab et Taweel in D 16.
- 1 howitzer battery (4.5) behind the village of Arab el Hish in D 25.
- 1 heavy battery (60 prs.) at D 2.9—2.1.
- R.H.A. (with cavalry brigade).
- 1 battery (13 prs.) behind the embankment of old Suez railway in F 47.

MEDICAL ARRANGEMENTS. I ARMY CORPS.

SECRET.

(1) The walking wounded collecting post of "Z" Division will be cleared under arrangements made by the "Q" branch of this corps headquarters. Ten three-ton lorries fitted up with seats will be allotted to clear this W.W.C.P. Slight cases will be taken to No. 1 Stationary Hospital at Nasrieh College.

(2) 450 stretchers have been allotted to "Z" Division from the reserve held by D.M.S. They are stored in the Red Barracks, Abbassiya.

(3) A.D.M.S., "Z" Division, will arrange to draw these stretchers before midday, February 6.

(4) Acknowledge.

February 5, 1922.

Colonel.

D.D.M.S., I Corps.

Copy No. 1.—D.M.S., Army.

" " 2.—A.D.M.S., "Z" Division.

" " 3.—File.

DISPOSITION OF CAVALRY BRIGADE AT ZERO HOUR, FEBRUARY 7.

Headquarters cavalry brigade at F 3.8—7.4.

One battery R.H.A., behind embankment of old Suez railway in square F 47. One squadron of "A" cavalry regiment, in palm groves east of Abu Sir in square F 09.

Headquarters and three squadrons. "A" cavalry regiment, in square F 28. "B" cavalry regiment in square F 49. "C" cavalry regiment, in square F 69.

Headquarters and cavalry field ambulance with dressing station opened at F 3.5—7.2.

The cavalry brigade is to be considered a "detached" cavalry brigade and to be directly under army corps headquarters for orders.

It is to be assumed that it has received orders to engage the hostile cavalry covering the enemy's left flank, to defeat it, and at all costs to get round the enemy's flank.

From information received from natives during the night it would appear that one enemy cavalry regiment bivouacked during the night, February 6-7, in Square J 12, and another in Square J 43.

(To be continued.)

ENDOPARASITIC ACARI AS A CAUSE OF URINARY DISEASES.

WITH NOTES ON SEVERAL CASES.

BY LIEUTENANT-COLONEL J. MACKENZIE.

Royal Army Medical Corps.

Assistant Director of Pathology and Hygiene, Western Command.

MITES have long been recognized as a cause of skin disorders, both in man and in animals.

It is a new departure to have to take them into consideration as possible internal parasites, setting up pathological conditions in the internal organs. Evidence is, however, accumulating that requires careful sifting and examination.

The following cases are recorded as being of interest in themselves and as an addition to the list of cases already on record.

Case 1.—In January, 1921, at Shorncliffe, a specimen of urine from a case of nocturnal enuresis was received in the laboratory. On examining the urine in the conical glass in which it arrived from the ward, it was noted that there were a number of small black or brownish-black particles in the sediment, the urine itself being clear and of low specific gravity.

On microscopic examination the sediment was seen to be of an unusual type, consisting principally of small angular pieces of brownish-black or black material; these were hard in consistence and required considerable pressure on the cover-slip with a dissecting needle to break them up.

It was then noted that long hairs or spines and what appeared to be detached jointed legs were present in the sediment, suggesting the presence of some small animal body. In some cases these appeared to be protruding from the black pieces of debris. Diligent search was now made and resulted in the finding of a mite and two oval bodies, presumably ova.

The patient was sent for and on his coming to the laboratory a specimen of urine was obtained in a specially cleaned conical glass. This was seen to contain small black and brown particles, which quickly settled at the bottom. Microscopic examination revealed the presence of several mites, more or less obscured by the debris, and a few ova.

Similar findings were obtained in specimens of urine passed during the next forty-eight hours, after which the debris became very much less and mites could no longer be found, although a few hairs and scales were present for a day or two longer.

The history of the patient was as follows:—

Private H., aged 19; service nine months; born in London and has never been out of England. He left school at the age of 14 and worked at electrical engineering and at rubber works in London, later with dyers and cleaners, then as a carman driving and cleaning horses, and latterly at pipe

340 *Endoparasitic Acari as a Cause of Urinary Diseases*

and boiler covering for six months in Newcastle, this being the only time he was ever out of London. He enlisted in the Army in March, 1920. As a child he was "bilious and weak" ("come all over hot and sweating") with occasional vomiting; when about nine years of age attacks of this kind were very frequent—often every week.

He has never had scabies or pediculosis, and has never been exposed to venereal infection. He has always had incontinence of urine since babyhood, and "wets the bed" every night with few exceptions, as far back as he can remember. Two or three years ago he was an out-patient of a London hospital for incontinence and attended for six months, the urine being examined only once during that time. After enlistment he was on one occasion punished with seven days' confinement to barracks for nocturnal enuresis. He has had no local pain of any kind except on one occasion about three years ago, when there was cutting knife-like pain in the crutch; this lasted for a week or so and passed off.

As stated above, he was admitted to hospital in January, 1921, and during the first few days mites and ova were found in his urine.

After the first discovery care was taken that only specially cleaned urine glasses were used, but a catheter specimen was not obtained. At that time I had not heard of mites having been found in urine and believed that they must have entered by the urethra, or that in spite of all precautions they must have been present in the urine glasses or obtained entry to these afterwards. On looking up the literature a reference [1] was found to a case recorded in 1893 by Miyake and Scriba in Japan, in which these observers had found mites in catheter specimens from a case of hæmaturia and chyluria; to these they had given the name "*Nephrophages sanguinarius*"; the account is accompanied by drawings illustrating a male and a female.

On finding this reference, specimens of the mites recovered from this case were shown to Sir William Leishman, who agreed that they were acarines.

Unfortunately, the preparations were only roughly mounted and were not permanent.

After a few days mites were no longer to be found in the urine, the symptoms improved and the patient was discharged to duty.

Case 2.—In May, 1922, an officer was admitted to hospital in Dublin suffering from hæmaturia and frequency of micturition, with severe pain at the point of the penis on passing water.

A specimen of urine received in the laboratory on May 16 was cloudy with pus and had a heavy sediment of blood, the latter being arranged in layers at the bottom of the glass. A similar appearance having been noticed in bilharzia urine and the patient having served in the East, the sediment was examined with a view to finding this parasite.

Pus cells were present in masses, and red blood cells were numerous. Brownish-black angular particles were also observed, recalling to mind the

case above described. Careful search resulted in the finding of hairs and scales, and eventually of a female mite. Of this a rough camera lucida drawing was made, the features being much obscured by pus cells (fig. 1).

The patient's history was as follows :—

Since 1909 he had served in Malta, India, France and Mesopotamia, and latterly in the South of Ireland. Previous illnesses were: paratyphoid fever in Mesopotamia, 1916; jaundice in India, 1917; malaria in India, 1918, with several recurrences.

About the middle of April, 1922, he first noticed a certain amount of discomfort at the point of the penis on passing urine, and also between times, off and on. Micturition gradually became more frequent. A week or so after the first symptoms he noticed a little blood at the end of micturition.

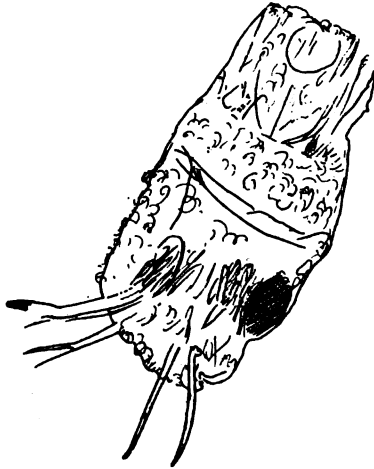


FIG. 1.—Female *Tarsonemus* sp? (Camera lucida drawing).

The discomfort became less, and for a time practically disappeared. On May 12 this symptom returned, and gradually became worse.

On May 16 (the date on which mites were found in the urine) the patient's condition was as follows: Appears quite well, temperature normal, tongue slightly coated with white fur, clean at tip and edges: complains of pain at the point of the penis towards the end of micturition and an aching feeling farther back: blood is passed at the end of micturition.

Arrangements were now made for the use of specially cleaned urinals and urine glasses. On the following day a fresh specimen of urine had an appearance similar to that described above, but with rather less blood. Black particles were visible here and there in the heavy deposit of pus. Microscopical examination again revealed the presence of blackish debris, hairs and scales. An imperfect mite or cast skin was found, the legs being

absent, though the four acetabula on each side could be seen projecting from the ventral surface. After prolonged search a male acarine was found imbedded in pus, the ends of the appendages being somewhat obscured by pus cells. This specimen was eventually mounted as a permanent preparation, and was submitted to Mr. Stanley Hirst for identification.

A catheter specimen was not obtained till May 19: in this a few black particles, and also hairs and spines were found, but no mites. On May 20 the patient was passing purulent urine at intervals of one and a half hours, with intense pain at or near the point of the penis. Insomnia was relieved by hypnotics.

On May 22 there was slightly less frequency but blood was again increasing. Black particles had disappeared from the urine. X-ray examination of the kidneys revealed nothing abnormal.

After May 31 blood disappeared entirely, but there was still a little pus. Micturition was taking place every two or two and a half hours, but without pain. The patient looked quite well, and had no symptoms whatever except rather frequent micturition and a little pus.

He left hospital on June 12. In a communication dated July 7, he states that naked-eye pus disappeared entirely about June 21, and the urine was clear; frequency of micturition had completely stopped; he was playing hard tennis and feeling quite fit again.

Although a catheter specimen was not obtained before mites had disappeared from the urine in this case, the precautions taken in collecting it, and the subsequent finding of mites and of the characteristic debris convinced me that the acarines were actually passed in the urine.

Case 3.—In July, 1922, while inspecting a number of recruits at a regimental depot in Wales, a recruit was brought forward for discharge from the Army on account of nocturnal enuresis. A specimen of urine was obtained, and the sediment examined after centrifuging in the laboratory. A small quantity of the characteristic brownish-black debris was noted: after searching for some time a piece of cuticle was found, with capitulum and two legs still attached, and two disarticulated legs lying near by. These four legs were all identical, five-jointed, and provided with spiky hairs. A few detached spiky hairs were also found. This urine contained 0.2 per cent of albumen. Small pieces of bladder epithelium were present, and many single epithelial cells.

History: This recruit states that when 8 years of age he began to "wet the bed" about once a week. At the age of 14 an improvement set in and there are now intervals of two or three weeks.

DISCUSSION.

A careful search was made of all the literature available, with a view to finding, if possible, any recorded cases of a similar kind, and also of studying the subject of acarine parasitism of animals.

Carnegie Dickson [2] records a case which occurred in 1915, in which several mites and ova of the species *Tyroglyphus (Aleurobius) farinae* De Geer were found in the urine of a patient suffering from albuminuria, and in which cystoscopic examination showed an abnormal condition of the trigone.

The same observer (*loc. cit.*) records a fatal case of obscure illness characterized by general glandular enlargement, splenomegaly and an abnormal blood picture, associated with the presence of mites, *Tarsonemus* sp. ?, in the urine. In this case special precautions were taken to prevent contamination. Disarticulated legs were found in a catheter specimen from the bladder, and an immature nymph in a catheter specimen from the right ureter.

M. Khalil [3] records the finding of acarine ova in the fæces of 8 per cent. of 130 Cornish miners examined and of adult mites swarming in the fæces buckets brought up from the mines. These were identified by Mr. Stanley Hirst as belonging to (a) *Aleurobius farinae* De Geer and (b) *Glycyphagus* sp.? the former being usually found in wheat, cheese, sugar, etc., and the latter giving rise to various skin lesions, e.g., "grocers' itch."

Castellani and Chalmers [4] make several references to the finding of mites in disease. A mite, *Tyroglyphus longior* Gervais is found accidentally in fæces, urine or pus. A mite, *Histiogaster spermaticus*, which feeds on vegetables, appears to have been introduced by means of a catheter and to have formed a cyst in the testis of a man in India. A mite, *Carpoglyphus alienus*, has been found in purulent urine passed by a man: "probably it was a contamination." Castellani in 1902 found embedded in the fat of the omentum of a negro in Uganda a mite *Cytoleichus sarcoptoides* Huguin, "which lives in the air sacs, and at times the liver and kidneys, of fowls." A reference is also made to the finding of mites as internal parasites in monkeys by Newstead and Todd.

Hirst [5] gives a very full and interesting account of the activities of the acari in relation to man and mentions a large number of skin disorders due to these parasites, including scabies, grocers' itch, copra itch, "Vanillisme," water itch, grain itch and many others. He states that specimens of *Tarsonemus* have been found in cancerous tissues taken from man and several domestic animals and adds, "Probably these mites were introduced into the preserved tissues by accident."

Certain species of acari are well-known as vectors of disease, e.g., the tick *Dermacentor venustus*, which conveys the unknown virus of Rocky Mountain fever; *Ornithodoros moubata*, which transmits the spirochæte of African relapsing fever; *Leptus (Trombicula?) akamushi*, whose bite is the cause of Tsutsugamushi fever in Japan. *Amblyomma hebraeum* transmits the disease "Heartwater" in sheep, goats and occasionally cattle.

The same author, dealing with the activities of mites in relation to animals [6], describes the acarine disease of bees as due to a Tarsonemid mite *Acarapis woodi*, which infects the tracheal tubes of the thorax and of

the head; "the tracheal tubes of bees are normally pale, but in advanced cases of the disease they become brownish or blackish, and this makes it easy to recognize the malady, for if the tracheæ of a bee are discoloured the mite is invariably present. The symptoms are due to blocking of the tracheal tubes, probably also to blood-sucking by the mites and possibly in part to a toxæmia due to the metabolic products of the parasites. It is too early as yet to be able to estimate the exact degree of importance of the discovery of this Tarsonemid mite as an internal parasite of the honey bee. It is probable, however, that it is the causal agent of the deadly malady usually called 'Isle of Wight Bee Disease.'" An interesting fact is mentioned, viz., that mites are very resistant to chemical fumes and it seems very unlikely that any method of fumigation can be discovered that will kill the mite without injuring the health of the bee.

The number of cases now on record seems to suggest that certain urinary disorders may be due to mites living endoparasitically in the mucous membrane of the urinary tract. It is stated that they invade the liver and kidneys of fowls and are found as internal parasites in monkeys.

It is not open to doubt that mites are frequently swallowed by man, e.g., the cheese mite and the mites recovered from the fæces of Cornish miners. Recent work on the life history of *Ascaris lumbricoides* and parasitic muscidæ shows that certain animal parasites do find their way to the internal organs. The burrowing propensities of mites and the carrying powers of the lymph and blood streams may conceivably account for the presence of mites in the urinary tract and the symptoms described in the above cases are such as would be explained by the presence of these minute arthropods in the kidney or bladder.

My thanks are due to Professor Gatenby of Trinity College, Dublin, and to Mr. Halbert, M.R.I.A., of the National Science Museum, Dublin, for their kind interest and advice in Case 2, and to Mr. Stanley Hirst of the British Museum (Natural History) for the identification and drawing of the specimen from the same case.

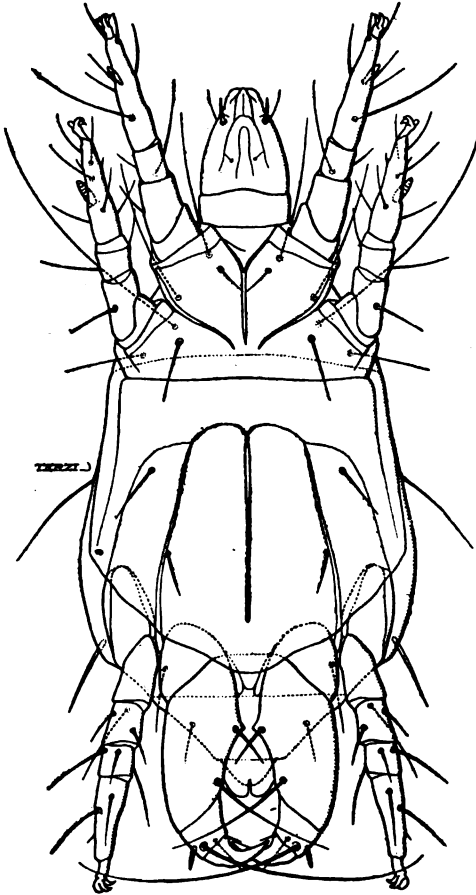
REPORT ON THE MITE (*TARSONEMUS FLORICOLUS* CANESTRINI AND FANZAGO), FOUND BY LIEUTENANT-COLONEL J. MACKENZIE, R.A.M.C., IN HUMAN URINE.

By STANLEY HIRST.

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A few cases of the occurrence of mites of the genus *Tarsonemus* in human urine have already been recorded. Blanc and Rollet found a *Tarsonemus*, which they identify as *T. hominis* Dahl, in urine passed by a patient suffering from cystitis (*C. R. Soc. Biol.*, 1910, vol. lxi, p. 233). Specimens of a *Tarsonemus* were also discovered by Carnegie Dickson on several occasions in the urine of a patient (*Journal Tropical Medicine and Hygiene*, 1921, vol. xxiv, p. 25), and this author certainly seems to have taken

precautions against the contamination of the urine during examination. He also collected examples of a Tyroglyphid mite (*Aleurobius farinae*) from the urine of another patient. Oudemans is of opinion that *Nephrophages sanguinarius* of Mijake and Scriba, 1893, described from specimens from the blood-stained urine of a Japanese, is in reality a *Tarsonemus*.



Tarsonemus floricolus (male).

The *Tarsonemus* submitted to me for examination by Lieutenant-Colonel J. Mackenzie, R.A.M.C., is a male of *T. floricolus* Canestrini and Fanzago—a species said to live in the flowers of *Verbascum*, in galls on several kinds of plants, in decaying substances and at the base of the feathers and on the skin of several birds. There are a number of examples of this species in the British Museum collection found on some mouldy chocolate forwarded for examination. Four pairs of hairs are situated on the dorsal surface of the cephalothorax of the male of this mite, those of

the third pair being considerably longer than the others. A short stiff seta or spinule is present dorsally on the fourth leg, near the claw, and there is also a long hair close to it which is longer in my specimens than it is shown in Berlese's drawings. The accompanying text-figure of *Tarsonemus floricolus* was sketched by Mr. A. J. Engel Terzi from Lieutenant-Colonel Mackenzie's specimen.

Since the above was written, four more cases have come to notice, as follows:—

Case 4.—In September, 1922, at Carlisle, a recruit was brought forward as having just begun to suffer from nocturnal enuresis, and the following notes were taken:—

Age 18: service six weeks; left school at the age of 14 and went to sea as a coal-trimmer for four years, until he enlisted in August, 1922; has never had any urinary trouble. A few weeks after enlistment he found his bed wet in the morning and reported sick "to see what was the matter with me." On being questioned as to pain, etc., he stated that three days previously, while out walking, he had a sudden attack of pain in the lower part of the abdomen and in the thighs; this lasted for twenty minutes and "doubled me up"; he fell down and was taken back to barracks in a taxi. After the first enuresis there was a recurrence every two or three nights.

A specimen of urine was obtained and had the following characters: reaction acid, specific gravity 1024, no albumin or sugar. Microscopic examination of the centrifugalized deposit showed black debris, epithelial cells and a few hairs. In every slide examined there were several tarsonemid mites, one slide having as many as eight (two males and several females and immature forms) and two ova, in the interior of which the larval mite could be distinctly seen. A Tyroglyphid mite, *Glycyphagus domesticus*, was also found.

The recruit was brought to the laboratory, the glans and meatus were thoroughly cleansed and the urine was received in a specially cleaned and autoclaved flask. Part of this was immediately centrifuged in sterile tubes and in the deposit a mite, *G. domesticus*, was found within ten minutes of the urine being passed. On the following day a catheter specimen was taken and in this a perfect female *Tarsonemus* was found. These specimens were mounted and shown to Mr. Stanley Hirst.

Case 5.—An officer with "trench nephritis" and the following history (partly from the patient, partly from his medical attendant and partly from records). At Ypres in October, 1917, he began to have headache and backache and a "tired ache in the limbs," but did not report sick. In the following month he appeared before a Medical Board in London to be examined for transfer to the Indian Army, for which he had applied some time previously. He was found to have albuminuria and was admitted to hospital. The albumin was 0.3 per cent. He was in hospital for six

months and had then "a lot of albumin and a few casts." After eighteen months light duty he was again in hospital, then on light duty for eighteen months and recently on several months leave. He still complains of back-ache, a drawn feeling in the head and back, and pain when passing water first thing in the morning.

Extracts from Records.—April 1918: Albumin 0.1 per cent. August 1920: Looks well. Albumin present. Is on duty. February, 1921: Looks well. No anæmia. Considerable albumin; no casts; specific gravity 1008. September, 1921: Quite well except for headache and back-ache; no œdema; pulse 120. Albumin 0.25 per cent; specific gravity 1012; no blood; trace of hyaline casts. April, 1922: Heart normal. Pulse 75. No anæmia; no œdema. Specific gravity 1009, albumin 0.05 per cent; no organisms.

It will be noted that this history extends over a period of five years, commencing with "trench" or "war nephritis."

In October, 1922, a specimen of urine was obtained and examined; reaction acid, specific gravity 1009; albumin 0.125 per cent; no sugar. Deposit: epithelial cells and blackish debris. A female *Tarsonemus* was found after prolonged search.

Case 6.—A recruit at Ashton with nocturnal enuresis, October, 1922. Urine acid, no albumin or sugar. Deposit consisted of masses of epithelial cells with brownish-black debris: in this a perfect male *Tarsonemus* was found, with black debris entangled in the claws of the first three pairs of legs.

Case 7.—A recruit at Preston with nocturnal enuresis of six years standing. Urine acid, no albumen or sugar; a few epithelial cells and black debris. A female *Tarsonemus* was found, with black particles adhering to it.

The black debris noted in these cases appears to be derived from the mites' excrement, which I have seen being extruded in the form of a round black ball.

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MEDICAL ARRANGEMENTS OF AN INFANTRY DIVISION IN OPEN WARFARE.

BY COLONEL R. S. HANNAY, C.M.G., D.S.O.
Royal Army Medical Corps.

IN discussing this subject, a narrative is presented of the broad outlines of the medical arrangements for the open warfare in which the 1st Division British Expeditionary Force was engaged during the last three months of the Great War.

The adaptability of the Medical Services to such conditions after a long period of trench fighting was due to :—

(1) The experience gained from August, 1914, had been carefully passed on and a spirit of improvement and emulation cultivated.

(2) The *esprit de division* was only second to *esprit de corps*, and friendliness with readiness to help was universal.

(3) The Regimental Medical Officers had in many cases been with their Battalions for long periods, returning again and again after recovery from wounds and sickness. They had all previously served in one of the Field Ambulances. No praise is adequate for such a gallant band of officers who with no prior military training had rapidly proved their efficiency.

(4) The Ambulance Commanders were regular officers ranging in length of service from seven to thirteen years, who possessed that essential qualification—the rapid realization of the necessities of an emergency—to a very marked degree.

(5) The Division had been concentrated in Le Clipon camp for three months and specially trained for a combined naval and military operation involving a landing in $1\frac{1}{2}$ feet of water under a smoke screen and the scaling of a forty-five foot sea wall. Medical stores had to be taken for 6,000 casualties which were practically certain not to be evacuated for one week.

The only transport allotted consisted of two large motor ambulances per Field Ambulance, so that full loads of medical supplies had to be carried by the R.A.M.C. personnel. All superfluous and non-essential articles had therefore been rigorously eliminated and a thorough training given to the whole personnel in the handling and use of the selected stores.

(6) Thirty-two regimental stretcher bearers per battalion had been trained. These men carried the whole of the medical equipment of their unit in the landing operation mentioned above.

(7) A scheme had been tested and gradually standardized for the transport of the entire equipment, etc., for an Advanced Dressing Station in a light cart or G.S. limber. Each ambulance had one such load per section, ready for instant use with the A.D.S. party detailed.

(8) The operations for which the Division was trained at Le Clipon did

not, however, take place ; but the experience gained in organizing and in eliminating all non-essentials was very valuable.

As a result of the Le Clipon experiments, the equipment of one Field Ambulance section had been returned to store, extra dressings, blankets, stretchers and medical comforts being carried in the transport thus rendered available.

This system was continued during the operations now to be described.

To a considerable extent the traditional aims of the A.D.M.S. and D.A.D.M.S., passed on by their predecessors and in turn by them, assisted in the intensifying of the camaraderie which is so vital a factor of success.

These aims might well be called axioms and are worthy of memorization :—

(a) Get to know your own officers and men, by repeatedly seeing them, sympathetically listening to their troubles, and proving to them that *you* are their great friend in need.

(b) Constantly visit, both officially and socially, the Divisional and Brigade Staff Officers and show them you are out to help them in every possible and reasonable way.

(c) Spend as much of your time as you can in seeing the officers and men of the various units in your division, whether in or out of the line, and try in every way to assist in their cheerfulness and well being.

(d) Remember your recommendations for the improvement of the conditions in the forward area must be based on your own personal observations.

(e) You only exist in war to keep the fighting man fit for his job ; to prevent sick wastage by every means you can think of ; and to ensure the adequate treatment and rapid evacuation of casualties.

(f) Your personal example carries a lot of weight, therefore hide your feelings of panic in a stafe and keep cool and cheery.

(g) Discuss by conferences with your own officers the broad lines of your medical policy and be quick to adopt the practical out of the many brilliant suggestions that will surely come your way.

Bearing the foregoing in mind the simple and elastic medical arrangements can be more easily understood.

The Division fought in the 9th Corps for the period already stated with very little rest. It battled its way over the St. Quentin and Sambre et l'Oise canals until on November 4, 1918, it had recaptured Hantrève from which the Royal Munster Fusiliers, a troop of the 15th Hussars and a section of the 118th Field Battery had fought to a finish a delaying action ending at Etreux on August 27, 1914. This 1914 fight was continued until every round of ammunition had been expended and many had been killed or wounded.

In the last 1918 Divisional engagement the casualties suffered were under 500, the prisoners captured 1,793, with twenty-seven field guns and much material. A squadron of the Royal Scots Greys had passed through

our lines to continue the pursuit. Before this glorious final action many well defended positions had to be taken during three months of steady hard fighting, casualties had been heavy and the physical discomforts great.

The country was devastated, most of the habitations had been destroyed by shell fire, while shelling, gas shelling, and night bombing were severe. Medical posts had to be improvised in shell holes, trenches, cellars, or, with luck, out of stray small dug-outs of captured enemy positions. The fluidity of the front line was marked, and touch difficult to maintain.

The 141st Field Ambulance, less two bearer subdivisions, was used to form the corps main dressing station by the D.D.M.S., while No. 2 Field Ambulance had to supply the personnel for the Corps Walking Wounded Collecting Station.

No. 1 Field Ambulance was intact, and available for the service of the Division.

Casualties were heavy in the medical personnel, nine officers (three killed, three wounded, three gassed), and fifty-three other ranks, in forty-eight hours. Among the officers were the commanding officer, second in command, and the best bearer officer of one Field Ambulance.

Reinforcements were very few and far between, so that the efficient carrying out of the medical work of the Division became daily more arduous.

In the office of the Assistant Director of Medical Services a board, which showed the unit and name of every Royal Army Medical Corps officer, was kept up to date, and was of much assistance in replacements. A complete card index for every medical officer who had been or was in the Division was also kept in a neat box. These cards contained every possible particular, and saved much time and correspondence in rendering the many returns called for. To the excellence of the office records and general management, Captain J. W. C. Stubbs, D.S.O., M.C., formerly D.A.D.M.S., for nearly two years, had very largely contributed. This officer had served as a regimental medical officer and in a Field Ambulance. His knowledge and attainments were of the very highest value to his Assistant Director of Medical Services, and the Division in general.

Information as to impending operations was obtained at conferences presided over by the General Officer Commanding, and attended by Brigadiers, C.R.A., C.R.E., G.S.O.1, A.A.Q.M.G., and A.D.M.S.

The Deputy Director of Medical Services of the Corps had also conferences of Assistant Directors of Medical Services of Divisions to co-ordinate the medical arrangements.

Any further details of modifications of the original intention were immediately communicated to the Assistant Director of Medical Services by "G" Branch. This knowledge was imparted to the Ambulance Commanders actually engaged, at a conference usually held in the office of the Assistant Director of Medical Services and Royal Army Medical Corps ;

operation orders were drafted at the same time. These orders gave the medical dispositions in broad outline, leaving the Field Ambulance Commanders full liberty of action for emergencies.

Copies were sent to Deputy Director of Medical Services, "G," and "Q," and those concerned.

The medical dispositions with two Brigades in action were, with respect to each Brigade front:—

(1) The Field Ambulance Commander concerned was responsible for the clearing of his own Brigade front to his Advanced Dressing Station.

(2) His ambulance was at his disposal for this purpose, with one bearer sub-division of the 141st Field Ambulance as a reserve.

(3) The heavy cars of his ambulance, reinforced by heavy cars of Divisions not fighting, and a proportion of the 141st Field Ambulance motors, cleared his Advanced Dressing Station to the Corps Main Dressing Station.

(4) Lorries for walking wounded were supplied to him by the Deputy Director of Medical Services of the Corps, and reported at a point selected by him previously, when they came entirely under his orders.

The arrangements made by each Ambulance Commander were;—

Two or three stretcher squads were posted to each Battalion of the Brigade when in action. These were fed by and moved with the Regiment. They were entirely controlled by the Regimental Medical Officer, who could use them as necessary, provided that he cleared his aid post to the forward Field Ambulance bearer post.

A chain of bearer posts at intervals of not more than 500 yards reached back to the Advanced Dressing Station of the Brigade, and was manned by a varying number of stretcher bearer squads with a N.C.O. to each post.

Ford ambulance cars replaced hand carriage between the last bearer post and the Advanced Dressing Station when possible.

A field ambulance liaison officer was attached to Brigade Headquarters with a motor cyclist until officer casualties eliminated the former.

The chain of bearer posts was marked by directing flags, thus directing the walking wounded.

The Commanding Officer lived at the Advanced Dressing Station, leaving his second in command and Quartermaster with the transport and reserve medical supplies, etc., at the Brigade transport lines which were well in rear.

Two bearer officers supervised the clearing of casualties into the posts and maintained touch with the Regimental aid posts, each clearing the rear of a Battalion area.

The Commander personally visited all his bearer posts daily and aid posts if possible.

Two officers operated the Advanced Dressing Station and if available a third checked and attended to the walking wounded.

Soup, beef tea and hot drinks were always available at the Advanced Dressing Station, and to a lesser extent at suitable selected bearer posts.

A spare Advanced Dressing Station equipment was kept ready packed at each Advanced Dressing Station, to push forward and convert an aid post into an Advanced Dressing Station, at short notice.

Worn-out stretcher bearers were sent on relief by reserves to the ambulance headquarters for rest.

The bounds forward of the Division after each successful attack, necessitated similar pushing forward of the Corps Main Dressing Station, which could never cease receiving casualties. Roads became worse and worse until the devastated area was cleared on the last day's fighting.

It was therefore necessary to push the Corps Main Dressing Station as far forward as possible, Captain (Acting Lieutenant-Colonel) L. T. Poole, D.S.O., M.C., Commanding the 141st Field Ambulance, devised an ingenious scheme of organizing the Corps Main Dressing Station in halves, so that when one half was pushed forward and getting ready the other half still functioned. This scheme under his capable direction never failed the fighting Brigades and was of vital importance in the rapid and steady evacuation of casualties.

Brigade stretcher, blanket, and medical supply dumps were formed at each Advanced Dressing Station, with reserves at Field Ambulance Headquarters, while the Corps dump was at the Corps Main Dressing Station.

Evacuation of the Corps Main Dressing Station was by motor ambulance convoy cars to the Casualty Clearing Stations. These latter eventually had to be pushed forward from railhead and a chain of Casualty Clearing Stations formed to link up with rail transport.

The Corps Walking Wounded Collecting Station was at first well in advance of the C.M.D.S., and close to Advanced Divisional Headquarters. It gradually was amalgamated with the C.M.D.S. and walking wounded were collected at and evacuated from the Advanced Dressing Stations.

The daily round of the A.D.M.S. was to visit the Advanced Dressing Stations and as many posts as possible, report to G.O.C., G.S.O.1, and A.A.Q.M.G., visit the C.W.W.C.S., and C.M.D.S., and then relieve the D.A.D.M.S., in the office, who proceeded forthwith to do the same round.

Arrangements had to be made for the collection of sick from the Brigade in reserve and units not engaged in the forward area. Field Ambulance Headquarters formed centres for such, the sick of the back area units being disposed of direct to C.M.D.S.

Inspection of drafts, supervision of bathing arrangements, sanitary inspections of back area units' lines, and the many other duties of an A.D.M.S., had to be carried out when possible.

The strain was increased at first by lack of sleep due to night bombing, but later on no noise seemed to interfere with the limited time for rest available.

In conclusion, I hope we may be equally fortunate in the next war to have the loyal friendship of such brave men as my officers of the medical services of the 1st Division. To their devoted work the success attained was due, and they were well worthy of the esteem and respect which was heartily given them by the whole Division from the G.O.C. down.

Personally, it is my conviction that the highest efficiency can only be attained by continually striving to know your own duties and your own men of whatever rank they may be; and in obtaining through mutual respect and friendship the maximum of work with the minimum of irritation.

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NARRATIVE OF A MARCH INTO KURDISTAN DURING THE REBELLION OF 1919.

BY CAPTAIN J. C. BURNS.

Royal Army Medical Corps.

THE hot weather was once more upon us and from 10 a.m. till 4 p.m. the air was red-hot and sore to breathe. Overhead a pitiless sun in a brazen sky shone down on a parched and thirsty land. Along the Tigris four miles above Baghdad stretches a grove of palm trees and in June, 1919, these palm trees afforded some shade to the two miles of tents that sheltered the British and Indian troops who hoped to spend the next four dreary months in peace if not in comfort in this camp of Chaldari. But for some of us this was not to be. War clouds had already settled over the mountains of Kurdistan and their shadow extended as far as Baghdad. Since the armistice and the withdrawal of large bodies of troops down river from the outlying districts, discontent had shown itself among the Kurdish tribes. Sheik Mahmud, the paramount ruler of Southern Kurdistan, rose in rebellion in May. The British officials in Suleimanyah, the capital of this province, were besieged and their massacre was daily feared. The tribes, it appears, had been able to obtain supplies of arms and ammunition from the Turks retiring in disorder before the British advance from Kifri to Altun Kupri in 1918. A flying column in Ford cars was hurriedly got together at Kirkuk and accompanied by some L.A.M.B. cars set out to the relief of Suleimanyah. They succeeded in getting two-thirds of the way, but while bivouacked in the Tachludga Pass were attacked in force by the Kurds and forced to retire to Chemchemal. Two armoured cars, unable to elevate their machine-guns sufficiently to bear on the tribesmen hidden behind rocks on the hillsides, attempted to rush the lower slopes and give the convoy time to get clear of the pass. Owing to the broken nature of the ground and the low clearance of the cars both were put out of action. The British crews were captured, but thanks to the presence of Sheik Mahmud himself, their lives were spared and the men were taken back under safe conduct to Chemchemal. This engagement greatly encouraged the spread of the insurrection, and Halebja, lying to the east towards the Avromân mountains, was entered by hostile elements. The Political Officer only just succeeded in escaping with his life. Such was the situation in the month of May. Urgent action was now necessary to suppress this rebellion before the sporadic outbreak became an epidemic. Troops of the 18th Division were concentrated therefore at Kirkuk, the objective, Suleimanyah, being reached via Chemchemal and the Bazyan Pass—the latter a deep, narrow cleft in a chain of mountains running at right angles to the only practicable route into Southern Kurdistan. It afforded a position of great natural strength and was likely to be held in force by the Kurds. While the main operations were to take place from the west by the 18th Division, a column from the

17th Division was to proceed by the Persian border and enter Southern Kurdistan from the east by the Avromân mountains. This column was composed of troops encamped at Chaldari. The column was to be commanded by Colonel B. of the "Buffs"; Major W. of the Royal Engineers was Brigade Major; Captain M. P. was Staff Captain; Captain C. the Supply Officer. The troops consisted of one battalion of Gurkhas, two companies of Baluchis, a pack wireless section, a company of sappers and miners, and a "medical unit." I was detailed to take over the medical unit. Later, while on our way to the Persian frontier, we were joined by a section of mountain battery, a pack ambulance and a small survey party.

Little was known regarding the route we were to follow, the maps available were by no means complete. The route was said to be practicable for pack animals and it was said that during the war small parties of Turkish troops had crossed to Kermanshah by these mountain paths. I think it is safe to say we were the first body of British troops to penetrate this strip of border country. Just prior to the outbreak of war the Turco-Persian Boundary Commission passed over part of this country and did some valuable survey work.

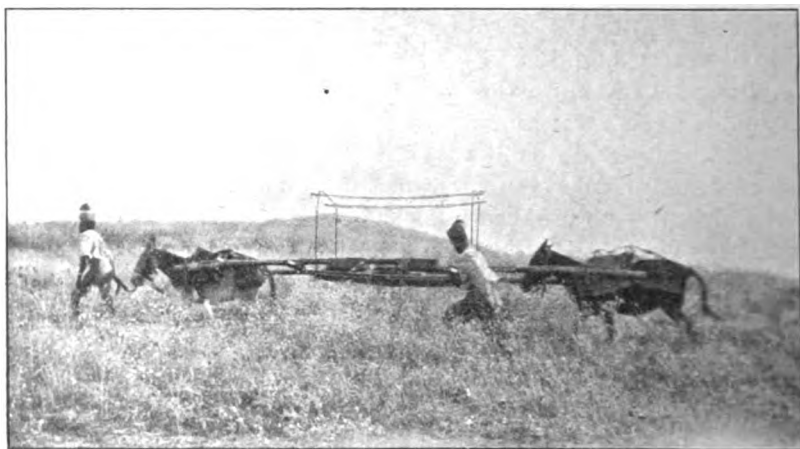
It was considered probable that the column would be out of touch with any lines of communication for a period from three weeks to a month, so that the column would have to be self-contained. The Assistant Director of Medical Services of the Division informed me that all sick and wounded, once we had left the railway, would have to be carried with the column. No wheeled transport could be taken. The question of the transport of casualties over these mountain tracks was likely to prove a difficult one and one felt that even under the best conditions the lot of the sick man was likely to prove a rough one.

For cases able to ride we could utilize the pack mules of the supply column as their loads were used up as rations. Naturally the supply of such spare mules would increase from day to day. As regards lying cases or others who could not ride or be supported on a mule, they would have to be carried on stretchers by the dhoolly bearers. A patient who had to lie on a stretcher and be carried for hours on end in the fierce heat of a Mesopotamian midsummer, would require some arrangement to provide him with shade from the sun's rays. On the suggestion of "medical division," the sapper company forming part of the column constructed a number of three-sided supports out of thin iron bars (see photo No. 1). Two of these iron supports were needed for each stretcher; the ends of the uprights fitting into small slots at the base of the stretcher handles. Connecting the cross pieces at each end of the stretcher were two palm fronds—they were very light and yet sufficiently rigid to support the blankets which were to be thrown over this framework. Two blankets were needed for each frame and were arranged in such a way that the portion forming the roof was double. One side of this contrivance could always be kept open and allow of a free circulation of air. On the march, when not required, the iron frames were collected together and carried on a pack mule. The palm

fronds were folded up in the canvas of the closed stretchers. Later, while in bivouac at Suleimanyah, these stretchers with their frames were most useful for rigging up mosquito nets to protect the sick from the myriads of flies, mosquitoes and sand-flies that made this particular camp a torment.

As regards the medical and surgical equipment carried, it was the operation scale of a section of a combined field ambulance. Extra medical comforts were taken and four 160-lb. tents for sick. The personnel of the unit like the rest of the column was on summer operation scale and no tents.

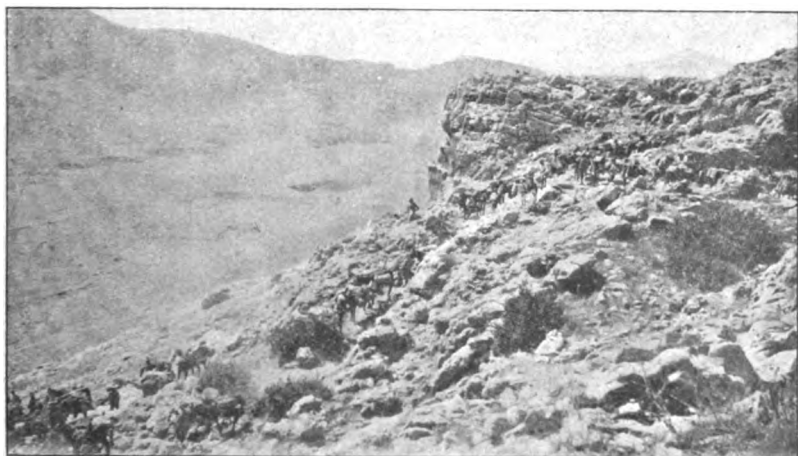
As the country was rocky the mules had to be shod all round and more than usual attention had to be paid to the condition of the men's boots. New pakhals were obtained from Ordnance, etc. On the evening of June 2 the column entrained at Chaldari and we set off on the first part of



PHOTOGRAPH No. 1.—Showing the mule "litter" on the march equipped with the framework to which blankets can be fitted to provide shade for the patient.

our journey towards the Persian railhead. In the morning, while it was yet cool, we detrained at a "station" called Musa Atmah and here we went into camp. It was a delightful contrast to the sun-baked plains of the Tigris and on all sides the country stretched away in a series of grassy billows, mounting higher and higher and changing colour till they melted into the distant blue haze of the Persian mountains. We camped here for some days practising the rapid formation of perimeter camps and getting men and animals fit for the march. Orders were received to move up the railway another twenty-eight miles, where we were to await the arrival of the Political Officer from Halebja who was to act as guide. The section of mountain battery had joined us at Musa Atmah and now the pack ambulance under Capt. M. of the I.M.S. joined the column. This unit was got together specially by General Headquarters and this was the first occasion for it to be used in the Force. The chief feature was the provision of "cacolets"—on either side of a pack saddle was a variety of skeleton chair into which a sick or wounded man could be

buckled. Some of the mules provided for this unit were not up to the weight of two men and equipment. The small Gurkha rifleman could be tucked into the cacolet more or less successfully, but a stalwart Baluchi sepoy was quite a different matter and a considerable amount of trouble had to be taken to ensure even distribution of the weight. As far as I can recollect there were twenty of these cacolet mules, so that the actual transport of suitable cases was made more efficient. I now thought that I would feel easier in my mind if I set about making some conveyance for a seriously ill case and decided upon making a mule "litter." For the construction of this I enlisted the help of the two sapper officers and the result was that if I provided the materials they would see that it was compactly put together. There were some E.P. tent poles lying in a dump waiting to be sent to Baghdad and the Staff Captain kept a jealous eye upon all articles in the dump. On waylaying



PHOTOGRAPH No. 2.—Shows the column among the rocks on the mountain side.

the Staff Captain I told him my desires, but he did not seem to be at all keen on handing over the four tent poles I wanted. I therefore carefully explained what an excellent chance there would be of carrying a case of beer on the litter until a suitable patient turned up. In a few minutes the tent poles were in the sapper camp. Two of these stout bamboo poles were needed for each side. Cross pieces were lashed between the poles and to the cross pieces an opened stretcher was attached. Slings were firmly lashed to each of the four ends of the long poles to be attached to the hooks on the mule saddles. The Transport Officer looked out two of his most docile and intelligent mules and two good drivers. It took the mules quite a few minutes to get used to this weird piece of apparatus. As events proved later this litter was quite useless on those parts of the march where the track was steep and tortuous. The rigidity of the frame prevented the mules from "cornering" and many times I was tempted to throw the whole thing down one of the numerous ravines we crossed. On

open country it was excellent, and as it happened my British nursing orderly developed acute appendicitis on the march and was conveyed across country a distance of thirty-five miles to the field ambulance at Suleimanyah in comparative comfort.

The column was now ready to march, the Political Officer arrived, and then the Commander-in-Chief arrived, inspected the column, and wished us "bon voyage."

Our first march was a short one, the second a good deal longer. We camped that evening in a piece of ground thickly covered with thorn scrub, so that the men had a busy time clearing the camp site. The thorn, however, provided us with ample fuel, and soon the dusk was illuminated with the cheery glow of the cooking fires. Mosquitoes from the scrub, however, soon began their devilish biting, and one was glad, indeed, to get under a mosquito net. "Surveys" and I messed together, and

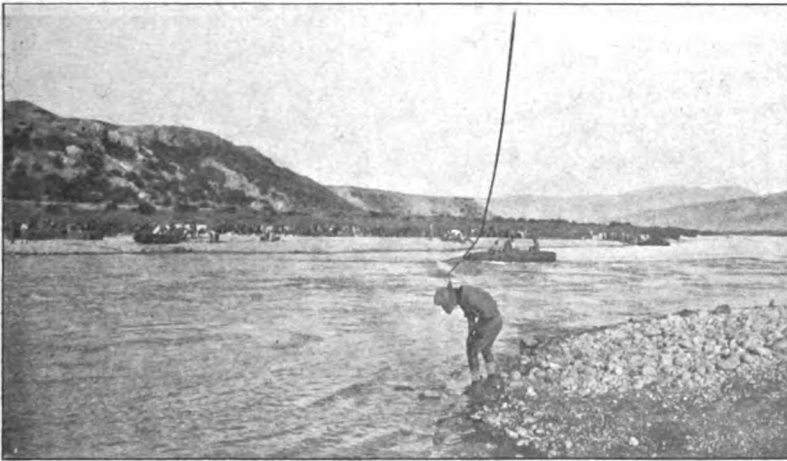


PHOTOGRAPH NO. 3.—The valley of the Sirwan River taken from the line of march 1,000 feet above the river.

although the unit cook was somewhat deficient in the knowledge of what the "Sahib log" liked to eat, my orderly, Jhan Mohd, made good the deficiencies.

Each evening the Column Commander met the officers of the column, and he or his Brigade Major explained the route to be pursued the following day, and issued his routine orders regarding time and order of march, picquets, etc. Our time of marching was just before dawn, and it could be quite cold at this early hour. After a few marches the column developed the faculty of getting under way with the maximum speed and minimum of discomfort. Our route for the first four days was across wide rolling plains, and marching was fairly easy. Mountain ranges soon began to hem us in, and the nature of the ground became more difficult. A ridge of hills had to be crossed, and here we made the unwelcome acquaintance of marching over rocks. Our way was up a steep gorge, the narrow path

twisting in and out among huge boulders, while the surface underfoot was rough in the extreme, which cut up the boots very quickly. The sun striking on these naked rocks rendered the still air unbearably hot, but at last we reached the top. Our troubles now began, for the path ended in a precipitous slope which descended sheer into the valley far below us. The sappers, however, got to work with blasting charges, and cleared the path of the worst obstacles. The mules were allowed to come down as they liked, and one could not help but admire their agility and sure-footedness. One or two came to grief as a result of the loads slipping, but the damage was very slight. It took us ten hours to do eight miles that day, but our appetites were wonderful, and stewed "bully," chupatties, tea and tinned fruit was just the thing for dinner. As a result of the difficult country, there were many cases of foot trouble, and these were carried on the mules



PHOTOGRAPH NO. 4.—Crossing the Sirwan River. Showing the rafts on which equipment and stores were ferried across.

whose loads had been eaten. Next day's march was to prove the most trying of the whole operations. Up to now we had been able to find water without much trouble, but our guide warned us that the question of finding water in the next valley was very uncertain. Orders were given, therefore, that there was to be great economy in water on the line of march, as there was a likelihood of having to camp for one night away from a water supply. We started as usual about 3.30 a.m., and marched over stony ground through a desolate plain. This narrowed down to a valley between two ranges of barren mountains, and the air was oppressively hot. By mid-day we had had about enough, and were profoundly thankful for the order to halt for an hour and a half. There was no shade, however, and the rocks were almost too hot to sit on, and despite glare glasses and spine pads the heat seemed to penetrate to one's very marrow. Footsore and thirsty we resumed our march through the valley, and the track narrowed down to a path running through a wide

belt of thorn. To make marching still more uncomfortable, the path was deep in soft black dust which hung like a cloud over the sweating column in the shimmering, baking air. The men were now beginning to show signs of fatigue, and soon we were busy collecting the men who had fallen in their tracks from heat exhaustion. The mules were as bad as the men, white with lather, and with heaving flanks. The column had to push on, however, until a suitable camp site could be found. About 4 p.m. word was passed back that a stream was close at hand, and in about five minutes we came upon it. It was not much more than six feet broad edged with rushes, but there was water in it. As soon as the water was sighted the animals became frantic. Despite the imprecations and all efforts of their drivers to hold them the mules reared and plunged, dragging their yelling drivers through the scrub, in their headlong rush to the water, carrying all before them. In this struggling, kicking, plunging mob of maddened mules were about thirty Gurkhas—heat exhaustion cases—strapped into



PHOTOGRAPH No. 5.—A street in Halebja—typical Kurds.

cacolets. Down into the stream the animals plunged up to their bellies, careless alike of their loads animate or inanimate. The stream became a mud bath in which these wretched animals were wallowing with every mark of delight. The unfortunate patients were unshipped as fast as possible, and to my relief and astonishment no one was killed or drowned in the mud. Some had bruises to show, but the poor little fellows were already so done up they did not seem to mind what happened.

While this pandemonium had been going on the troops had continued their march to where the Brigade Major had found a suitable camp, about two miles farther on. It was not till some hours later that all the loads were collected and brought into camp. Fortunately, the most of our patients suffering from heat exhaustion were able to return to their units except a dozen or so who required treatment. As it had been such a long and trying march, the Column Commander decided to rest here a day and

give the men a much needed opportunity of washing their clothes. Boots were beginning to give way rapidly, and many of the animals needed re-shoeing. It was pleasant, indeed, to be able at last to strip off one's nether garments and let the running waters of this cool Kurdistan rivulet restore one to cleanliness. As a result of this delicious bath one's skin really seemed to fit. Both animals and men were much refreshed with the rest, and we resumed the routine of the march.

Next day was eventful in so much as we had the pleasure of seeing a real tree—the first one since leaving the palms of Baghdad. It was perched on the top of a hill and afforded the survey officer a chance of giving this hill a name and not a number, on his map. We had seen no human beings up to the present, no villages and not even the tent of nomad shepherds. The whole country we had passed over was destitute of animal life. The route was now ascending steadily and with the rise a change in the



PHOTOGRAPH No. 6.—The house of Adela Khanum in Halebja.

character of the vegetation could be noticed. Instead of smooth rounded hills with broad valleys covered with thorn and scanty grass we now entered an area of rugged mountains, deep ravines, down which coursed numerous streams of delicious ice-cold sparkling water. The slopes of the less precipitous ravines were clothed in long green grass studded with many flowers and here and there groups of small oak trees. The scenery was more varied and beautiful and as we crossed the numerous ridges we could look back over a view extending many miles to the Persian hills, round Kermanshah. The air was fresh and cool and marching became easier as there was more to occupy the mind. The track was still difficult, in many places where it traversed these ravines being at times scarcely a foot broad. On these occasions the mules were allowed to go free and the column moved over in single file. While crossing one particular nervy ridge, a mule belonging to the sappers lost its footing and rolled down the 900 feet slope in a cloud of shale and dust. Funnily enough, this mule was carrying

the gun-cotton. A few minutes later, one of my mules was hustled off the path by an impetuous animal coming up from behind. Down it went rolling over and over, scattering its loads in its fall. Anyone who has been in a similar column will know what load this unfortunate animal was carrying, viz., my few mess stores. Of great importance was the sole remaining bottle of whisky in the column and that bottle was in one of the boxes now careering in a cloud of stones and dust down the side of the Khud. The mule was not killed, but of course the bottle of whisky was broken to pieces. Two bottles of lime juice and one of Eno's were intact.

Clambering carefully down the slope we reached the unfortunate mule wedged in a crevice and while the men busied themselves with extricating the animal, I had an excellent opportunity of watching the whisky—that delightful elixir, the life-giving distillate of waving fields of Scottish barley ripened by the northern sun—drain slowly but surely into the thirsty earth. It was not a joyful moment.



PHOTOGRAPH No. 7.—A company of Gurkhas waiting to advance.

About midday we entered a beautiful wooded glade—the sylvan glade one reads about in books. Here we halted for tiffin. It was delightful to lie at the foot of a tree sunk deep in luscious cool grass and partake of cold bully, raw onions, biscuits and tinned cheese, and later, replete, lie back and watch the blue smoke from one's pipe curl up towards the leafy screen above. To lie with half-shut eyes in perfect rest with a delightful sense of lassitude in relaxed limbs, while the drone of insects, the soft crunching of the mules in the grass, and tinkle of their harness, gave an added sense of languor and drowsy peace.

At this point the detachment of the Baluchis was due to leave the column returning to railhead with the spare ration mules and some bad footbite cases. We had thus an opportunity of writing some letters and having them posted at the Persian railhead. Our "wireless" had also got into touch with the 18th Division, and we heard that the strong position

of the Bazyan pass had been forced and Sheik Mahmud wounded and a prisoner. The Division was continuing the march to Suleimanyah. We learned later of the dash through of the 32nd Lancers to Suleimanyah to release the prisoners before the routed Kurds had time to get back to massacre them.

Next day we reached the highest point of our march and before us opened a magnificent vista of tree-clad slopes descending gently to the green plains in the distance, through which wound the blue water of the Serwan river, on its journey to join the Dealah. On our right a precipice descended sheer into a rocky canyon through which the snow-fed waters of the river hurled themselves from rapid to rapid and the thunder of their wrath rolled up to us perched 800 feet above. By the aid of field glasses a Kurdish encampment could be discerned on the plain and on the opposite (right) bank of the river. Our path was now downhill and we pushed on



PHOTOGRAPH NO. 8.—A river in Kurdistan.

rapidly. Soon we began to pass patches of cultivation with here and there a rude hut of leafy branches. The banks of the streams we crossed were now becoming more thickly clothed in vegetation and here and there we traversed sheltered hollows bowered deep in close-growing clumps of rhododendron shaded by the fresh green leaves of walnut, oak and mulberry. Along the edges of the path grew in thick profusion blackberries and the wild rose. The scenery was delightful and the march almost a pleasure.

In the afternoon we passed a fairly large village and we camped a short distance away. Fresh vegetables were obtained, and some goats, and made a welcome addition to the rations. This village was the first of the characteristic Kurdish villages we had passed. It was built in two portions—a summer and winter. The summer quarters were higher up the slopes of the mountain and composed of thickly woven leafy branches. The more

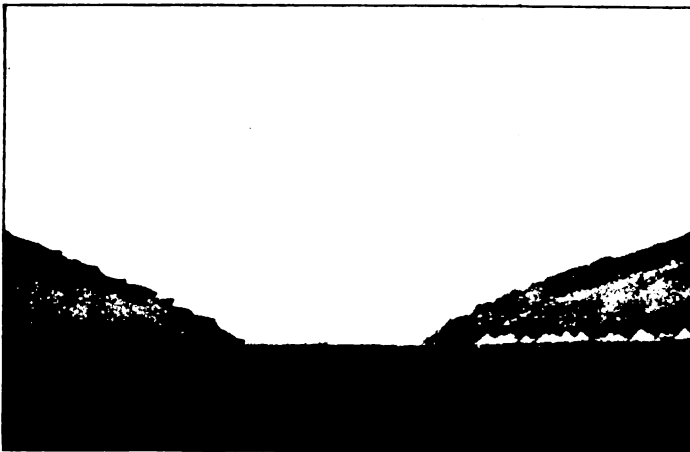
permanent winter quarters were mud huts without windows or chimneys. The reason for building two parts to a village is really to enable the happy villagers to escape from the flea-infested winter huts and gain a respite in their flimsy but more sanitary arboreal summer residences. The number of fleas per inhabitant and habitation in these Kurdish mountain villages is probably unique among all the races of Asia. Though one must confess one never noticed anything in the way of the "clawin posts" that a philanthropic and practical Duke of Argyll is said to have set up in certain parts of the Highlands of Scotland. Having done dispensary and midwifery practise in the slums of Edinburgh and Manchester, I thought I knew something about fleas, but a five minutes' stay in one of these hovels while bargaining for eggs with an ancient crone convinced me that I had much to learn regarding the powers of penetration and irritation of this humble insect.



PHOTOGRAPH No. 9.—In camp near Suleimanyah. The column "hospital" built of brushwood.

Our next march brought us across a wide stretch of open land to the river edge opposite the Kurdish camp, as this pointed to being the most obvious place to find a ford. The afternoon was spent by the "Staff" in making a careful survey of the river and the best means of conveying the column across the 100 yards of swift waters. The current was too strong to allow mules encumbered with loads to cross, and the sappers as usual proceeded to get over all the difficulties in the shortest space of time. The Political Officer was able to obtain some useful information from the Sheik of the encampment as regards the safest route. Two stout posts were well dug into both banks of the river and connected by a stout cable of rope. The troops were turned on to cutting grass, brushwood, etc., to be taken to the sapper camp for the making of improvised rafts. Skins were not available, otherwise very serviceable rafts or kalicks as are used on the Tigris could have been quickly constructed. Pits were dug, lined with large tarpaulins, and grass and brushwood well stamped in till

the pit was filled. The excess tarpaulin was folded over and firmly lashed and the cubical bale removed from the earth. The dimensions of these bales would be about 9 feet long by $4\frac{1}{2}$ feet deep and $4\frac{1}{2}$ feet broad. Two or three such lashed together make a very effective raft. All the stores were collected on the bank and amid much hilarity from the grinning Gurkhas the work of transport proceeded apace. To prevent the rafts being swept down stream a travelling rope connected to the overhead cable was utilized and fatigue parties on the banks pulled the raft over by means of other ropes. When the stores had been safely put over, the mule saddles and the sick were ferried over and the bulk of the equipment of the soldiers, for it was no easy thing to keep one's feet when wading up to the waist in those cold snow waters that come past so swiftly. Life lines were stretched across and the strongest swimmers of the column were stationed on the banks in case of accidents.

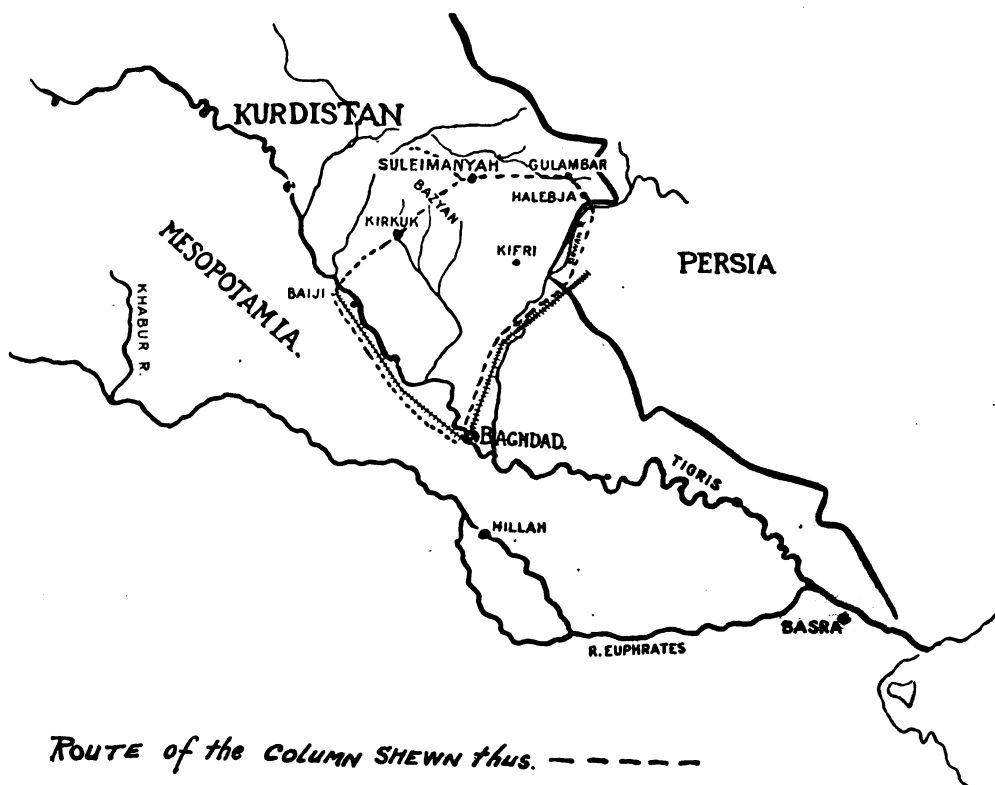


PHOTOGRAPH NO. 10.—The Bazyan Pass between Chemchemal and Suleimanyah.

However, although one or two went under, there were no serious results and a dose of brandy soon pulled round the few who were "shocked."

Our camp on the Halebja side of the Sirwan was near but not too near the Kurdish shepherds. There was nothing particular to note about the style of the camps, these being like all the other camps of the nomad shepherds one had seen along the Tigris from Basra to Mosul and from the Khabur river to the lower Euphrates. Long booths of black coarse material erected on rude poles, the interior divided into a series of compartments by mats made of reeds. The women lead a more independent life than their unhappy sisters on the Mesopotamian plains, but they still have all the hard work of the camp to do and are the hewers of wood and drawers of water. I was greatly intrigued by watching a group of Kurdish women who were churning butter. The apparatus was extremely primitive and had many "Heath Robinson" characteristics. The receptacle for the cream was a goat skin, and the rest of the apparatus consisted of some pieces of

rope and a tripod. Another point of interest was a baby gravely surveying the busy scene. It was tightly rolled up in a piece of scarlet blanket and lay in a swinging cradle. A second "Heath Robinson" bit of mechanism connected up the cradle and the foot of one of the industrious women, so that as she worked at her churn she could at the same time rock the cradle. This idyllic scene was marred however by the condition of the infant's eyes. Like so many other tiny tots one sees in every Arab village on the plains, the eyes were badly affected by purulent conjunctivitis and the sight of scores of flies clustering round those red oozing lids gave one a



feeling of intense nausea; strangely enough these children pay no heed to the flies and to all appearances suffer no discomfort from them. The mother was prevailed upon to bring the baby over to the camp, and there we cleaned up the horrid mess, although we knew that to-morrow the same state of filth would recur. As soon as the news got round that there was a "Hakim" all the chronics of the camp came along, including one old man completely blind who was evidently quite hopeful of an immediate cure. It is on such occasions the young medico wishes he had a magic wand of healing instead of some boracic lotion and a dose of Epsom salts.

We were enabled to lay in a stock of fresh meat for the column. Wireless communication was again established and we learned that a column of the 18th Division was marching to Halebja and would join our

column there. An aeroplane was also to fly over the route of the column and locate us. As many rebels had fled towards the mountains and Halebja, we thought there might be a chance of some fighting. We expected to reach the town that day and made an early start. We passed through a valley, and then our route lay past cornfields and orchards. The aeroplane as agreed swung round and round above us and then made off in the direction of Suleimanyah. We passed a certain number of Kurds, finely built men more robust than the lean Arab, covered in cartridge belts and armed with rifle, pistol and the inevitable curved dagger stuck in the folds of the wide Kurdish shawl that serves for a belt. We roped in five men that the Political Officer badly wanted and these we took along with us in handcuffs. Halebja was reached at about noon and the column bivouacked about 400 yards to the east of the town. There was no opposition and the inhabitants kept within doors. Thanks to the wonderful energy of the Staff Captain, and our supply representatives, a field oven was got going and white bread baked. The column of the 18th Division did not arrive till the afternoon about 4 p.m. Our column commander sent across a present of fresh meat and new baked bread to the new arrivals, and this no doubt gave them a hint of what a really wonderful column we were. The Political Officer borrowed the Union Jack from my unit (for which I obtained a receipt) and this was duly hoisted over the Political Serai as a sign to all that the town was in British occupation once more.

Halebja is the next most important town (or village) to Suleimanyah and boasts a telegraph and post office. It was in this lonely town disguised as a Persian trader from Sheraz that Major Soane, the Political Officer for Kurdistan, lived for three years before the war. His knowledge of the Kurds and the Kurdish dialects is probably unique. A very romantic figure lives in Halebja in the person of a middle-aged lady commonly known as "Princess Adela." She was of Persian stock but allied to the ruling Sheiks of this district. She appears to be a woman of strong will and of exceptional talent. By her orders the bazaars of the town were roofed over and a vigorous and a successful anti-Turk campaign was carried out. Princess Adela lived in one of the largest houses of Halebja, but it was just as insanitary as the meaner houses of the poor. A stagnant pool of foul water occupied the centre of the front courtyard. The front of the house was provided with balconies, and here the occupants could sit in the shade and enjoy the evening breezes. Several Kurdish ponies were usually to be found tethered round the courtyard and here and there groups of armed retainers. The Political Officer's house and offices were in a substantial building immediately adjacent to that of the "Princess," and here on the afternoon of the day following our arrival some of us were summoned to attend the administration of justice to the prisoners we had taken. The original sentences passed by a Military Court Martial had been commuted to twenty-one lashes with the cat. The punishment was carried out in the public square as an example to any in the crowd who might

wish to emulate the deeds of the rebels. The well merited thrashing was carried through with expedition and thoroughness, a British serjeant using the cat with the touch of a master hand. The prisoners took it well and appeared none the worse, and as soon as their quota of lashes had been received put on their rough garments and disappeared in the crowds lining the market square.

The General Officer Commanding the 18th Division arrived that afternoon from Suleimanyah. A dinner was given that night to the Political Officer and the officers of the column, but as my professional attentions were required by the General, I was unable to partake of the Kurdish hospitality. It was decided by the higher command that the column of the 18th Division should remain in occupation of Halebja and our column was to march to Suleimanyah via Gulambar, destroying certain villages high up in the mountains. These villages had been a constant source of trouble to the district, being the resort of brigands who, descending from their rocky fastnesses, made raids on Gulambar and the villagers round Halebja. The route to Gulambar was across open country and save for occasional flooded areas from overflowing irrigation channels there were no difficulties to overcome. We camped beside a swift flowing stream, a few hundred yards above the small village of Gulambar—the village of the “amber rose,” and indeed it was a most picturesque collection of Kurdish huts. There appeared to be a fairly large water mill built of stone and the mechanism for turning the grindstone appeared efficient although primitive. Just below the houses is a delightful grove of poplars and willows along the banks of the stream and behind an orchard of fruit trees with clumps of roses. From here the mountains rise sheer from the plain and there, with the aid of glasses, three villages could be made out perched high among the rocks, typical robbers’ nests. The alarm had already reached the villages and men and women could be seen streaming from the huts carrying bundles. They appeared to be making for a “friendly” village away to our right.

It was arranged that the three villages should be attacked simultaneously and the huts razed to the ground. The column assembled at the foot of the mountain and the three small columns deployed towards their respective objectives. Each column consisted of a company of Gurkhas, a section of the sapper company and some British signallers. The two mountain guns remained with column headquarters and the transport. As was to be expected, as soon as the troops began to scale the heights the tribesmen evacuated the villages and began to clamber up the precipitous rocks behind. Their withdrawal was hastened by very accurate shelling from the guns. After a hard and fatiguing climb the column surrounded the villages and proceeded to their work of destruction. The more substantial huts were blown up by the sappers and then set fire to. The three blazing villages made vivid points of colour against the grey rocks and served as an object lesson to the tribesmen for many miles around. This, however, did not put a stop to disorder, for some time later a detachment of the column

left in Halebja was attacked in the mountain defiles east of that town, and suffered many casualties. However, Halebja and its immediate district was well in hand and our worthy Political Officer left us to return to his lonely and responsible job of representing the British Government in Halebja.

Our march to Suleimanyah was rendered unnecessarily difficult by unreliable guides, and for two days our march led through swamps which appeared to be infested with more flies and stinging insects than one ever imagined was possible. We also lost our Staff Captain one night, but he turned up safely the following morning, having spent the night with some friendly Kurds.

On the third day we came in sight of Suleimanyah and camped at Kalasan Bridge, five miles beyond where a brigade of the 18th Division was in bivouac. Our marching was not yet over, for we were ordered out to search the valleys to the north-west, in which direction several large bands of rebels had fled after the battle of Bazyan. The country was difficult and our first day's march took us over a shoulder of a mountain to an altitude of 7,500 feet. On descending into the valley on the other side one entered an area of desolation—the ground devoid of every scrap of vegetation and covered with a profusion of large boulders. As the valley broadened out the rocks gave way to scanty grass and thistles, and streams, fed by springs in the mountain range on our right, meandered through the grass land. On the banks of every stream was a village hidden in its orchard of fig trees, mulberries and walnut. Those "oases" were a constant source of joy to the eye wearied by the drab colours of withered grass and naked rock. These orchards were usually fairly extensive, being about twenty to thirty acres in extent, and it was delicious to enter the cool green avenues that led through the trees and listen to the soft lappings and gurglings of some hidden stream. The figs were almost ripe and many a pound of this luscious fruit found its way into Jahn Mohd's haversack for the refreshment of his "Sahib." Mulberries both white and purple were in season and it was no unusual sight to see the men of a picquet squatting in the shade of a tree, crimson from face to feet with the juice of the berries. Other delicacies these areas of cultivation offered were spring onions and cucumbers.

Our farthest point was marked by a small river, probably one of the head waters of the Lesser Zab. The rapid flow of the clear water rushing tumultuously over mossy rocks between high banks covered deep with willows was very reminiscent of a Border stream, and on my part it required no great effort of imagination to believe I was standing once more on the banks of the Yarrow. This Kurdish stream was full of trout and a supply was obtained for the "pot" by bombing some of the quiet backwaters with small slabs of gun-cotton and Mills grenades. Later, when we returned to the Divisional camp near Suleimanyah, we carried on this practice as we found ourselves on two-thirds operation scale rations and short at that. However, this source of food supply was soon closed to us by a Brigade Order which read somewhat as follows: "In view of the fact that this

locality may be used as a Summer Hill Station for British troops it is desirable to protect the fishing in this river with a view to providing recreation for the troops. All bombing of fish will cease forthwith. Fishing by rod and-line, however, is permissible."

What the British troops thought of this locality as a Summer Hill Station is unprintable, but already a British military cemetery was showing an ever increasing crop of crosses as a result of malaria and dysentery. We resigned ourselves to the official ration and the trout swam merrily about undisturbed by further shocks of T.N.T. The end of nine days marching found us back again to the Khalasan Bridge camp and we all looked forward to the ten days' rest which was promised us. They were to prove days of extreme discomfort. To shield ourselves from the blazing rays of the July sun we constructed small huts of branches, and there we lay seeking some coolness from the furnace outside. The flies were overwhelming and made one's scanty meals a disgust. Sand-flies and mosquitoes kept one awake and prickly heat was added to one's torment. Men began to fall sick with malaria and sand-fly fever and in a week we had between 400 and 500 sick in our small column alone. All of us were attacked one time or another and the fever left its victims extremely weak. The Column Commander, the Brigade Major and the Staff Captain, all fell seriously ill and had to be sent off to Kirkuk. The only happy part was that we were beside a river in which a strong stream of clear cold water flowed all the hot weather. Driven from one's hut by the maddening bites of mosquitoes and sand-flies and with one's legs and feet bleeding from the scratching induced by prickly heat, it was delightfully refreshing to strip and lie in the cool clean water, usually with a small sweet melon held under water to keep it cool, to be eaten later when basking on the river bank.

Suleimanyah, the capital of this area of Southern Kurdistan, was disappointing. There were certain large well-built buildings in the centre of the town—one was used as Divisional Headquarters and the other was the Political Serai. The bazaars were roofed over and were therefore cool and dark. Part, however, of the bazaars had been looted when the tribesmen rose in revolt. One was able to buy excellent Japanese loaf sugar, sweet melons, mulberries, figs, limes and a few eggs. Blocks of snow could be purchased, a block of three pounds costing a rupee. The local wine was drinkable and was quite potent. The snow is got in the winter from the mountains behind the town pressed into blocks and stored in deep cellars or ice pits. The same process can be seen in Kermanshah and other towns in Persia. Another feature of the bazaar was the large number of Singer sewing machines. One great disappointment one never really got over was to find on our arrival at the 18th Division a complete absence of beer. To people in Britain this may seem a trivial thing, but in a land, and at a season, when one is a living thirst, it is no small matter. Water was available, no doubt, and although this is excellent for use in an emergency, yet as a means of quenching a continuous thirst with satisfac-

tion water is inferior to nicely iced beer. Asahi and Katura beer did much to ensure the success of British arms in Mesopotamia.

The East Surreys by a great feat obtained a case of beer and with sublime generosity they treated each officer in our column to a bottle.

We were now due to return to the Division at Baghdad. The column was split into two. One company of Gurkhas, all the convalescents, about eighty in number, and my unit were to march to Kirkuk, thence across the desert to the Tigris and entrain at Baiji, the then railhead. The other and major portion of the column with certain elements of the 18th Division were to march south across the Kara Dagħ to Kefri and thence to the Dyalah to the Baghdad-Persian railway. Although glad to receive orders to return to our units at Baghdad, the prospect of this 150 miles march to the railway under the late July sun was not inviting. The convalescents were put on empty A. T. carts as they were still unfit to march. Our march was via Tachludja, Bazyan and Chemchemal to Kirkuk. Prior to the insurrection, this road did not exist, being a mere caravan track, but now pioneers and sappers were working at high pressure converting it into an excellent motor road. This is the country of the famous Hamawand tribe whose raids were a constant worry to the Turks. The Turks maintained a large garrison at Kirkuk and a smaller garrison in Suleimanyah, yet despite the presence of these armed forces, every caravan had to pay toll. The Turks found it unsafe to traverse this part of the country with a force less than a battalion and even then these fierce hillmen would attack, cut off stragglers, and loot the baggage mules.

All along the road from Tachludja to Bazyan were grim relics of the fate of our motor convoys at the outbreak of the rebellion. Lying at the bottom of the nullahs could be seen the blackened twisted framework of the Ford cars with parts of the charred skeletons of the drivers. We arrived eventually at Kirkuk on August 1, but the last ten miles I was conveyed to Kirkuk by motor ambulance, having succumbed to the combined effects of fever, septic sores and dysentery.

The hospital at Kirkuk was packed with sick—malaria being very prevalent here. The officers' ward was a big base room beautifully cool, or so it seemed—the temperature even in this ward running up to 95°. Shade temperature being approximately 120°. Thanks to the excellent treatment I was well enough at the end of ten days to be conveyed to railhead on the Tigris by ambulance car. There I rejoined our little band and we arrived back in our camp on the river at Baghdad on August 12.

One feature of this march which surprised me was the endurance of the dhooly bearers. Not a single man fell out or had to be carried and except for the attacks of fever at Kalasan Bridge their health was excellent. In the Arab rebellion of 1920, I went with another section of the Ambulance to Hillah and in the operations there from July, 1920, to February, 1921, the power of endurance of these one time "followers" was remarkable.

Fortunately, the higher command in the hot weather of 1920 raised the dhooly bearer to the status of a fighting man, so that at last he was clothed and fed in a manner befitting a soldier.

Clinical and other Notes.

THE CHLORINATION OF MILK.

By CAPTAIN R. A. MANSELL.

Royal Army Medical Corps.

THE following experiments were undertaken at the suggestion of Lieutenant-Colonel E. W. Browne, I.M.S., and were carried out in the Peshawar district laboratory.

They were designed, originally, to discover whether or not milk could be kept from becoming sour during the hot weather by some cheaper, easier and more reliable method than that of boiling.

The milk used in these experiments was received fresh daily from the Government military dairy, pasteurized, and in sealed bottles; this being the standard supply of the cantonment.

The hour of commencing the experiments varied from one to three hours after pasteurization, the longer interval only being allowed when the weather was cool.

Some variation in the results as a whole may be accounted for by the fact that the shade temperature was steadily rising during the period in which the experiments were carried out from the neighbourhood of 80° F. at the beginning to over 100° F. at the end.

Chlorine was added to the milk in the form of a solution of bleaching powder giving, on titration, 1·87 per cent of available chlorine. The amount added is shown in the following tables, as the number of cubic centimetres of this solution per 100 cubic centimetres of milk. The corresponding quantities of the ordinary standard strength solution (1·38 per cent) are shown in Table V.

The percentage of fats was estimated by the Leffman and Beam process. The slightly decreased percentages of fats in the chlorinated milk may be due, to some extent, to the fact that after twenty-four hours all the cream had separated out from the milk and was not shaken back into complete suspension again, some small quantity adhering to the sides of the vessels.

The presence or absence of free chlorine was determined by means of the colour reaction with a solution of starch and zinc iodide.

The actual samples of milk dealt with were put up in wide-mouthed glass beakers which had been thoroughly washed—not sterilized or boiled—and the milk was measured from the bottle in which it was delivered into these and kept at ordinary room temperature covered over with thin gauze.

For the estimation of the colony content of the milk, measured quantities were plated on agar in Petri dishes half an hour after chlorination.

In dealing with infected milk, a quarter to half an hour before chlorination a measured dose of the organisms in question was added to the milk in the form of an emulsion of a twenty-four to forty-eight hour old living culture, the whole being thoroughly stirred with a sterile glass rod. The number of organisms was

estimated by the aid of opacity tubes. Necessary precautions were taken to ensure that the apparatus used was free from the organisms in question before the beginning of each experiment.

Cholera infected milk was plated out on Dieudonné's medium, the remainder on MacConkey's medium. All plates were incubated at 37° C. for at least twenty-four hours.

With regard to smell and taste, the majority of independent persons agree that chlorine is appreciable in milk treated with 2.5 cubic centimetres of bleaching powder solution per 100 cubic centimetres at the end of two hours but not at the end of three; similarly with the addition of 3.0 cubic centimetres of solution, chlorine is noticeable at the end of three hours but is not usually recognizable for long after that time, though chemically a trace of free chlorine can be demonstrated in the milk when it does not appear to be appreciable to the most sensitive palate. These observations were made on persons who did not know what they were expected to taste in the milk.

TABLE I.

No.	Original percentage of fats	C.c. of solution of bleaching powder per 100 c.c. of milk	Condition after 24 hours	Percentage of fats after 24 hours	Proportionate numbers of colonies per equal volume
A 1	4.5	<i>Nil</i>	Clotted	—	800
2	4.5	0.5	Sour	—	800
3	4.5	1.0	"	—	800
4	4.5	2.0	Sweet	3.5	160
5	4.5	2.5	"	4.0	136
B 1	4.5	<i>Nil</i>	Clotted	—	800
2	4.5	1.75	Sweet	3.75	93
3	4.5	2.25	"	3.75	41
C 1	4.75	<i>Nil</i>	Clotted	—	..
2	4.75	1.5	Sweet	4.2	..
3	4.75	2.0	"	4.3	..
D 1	4.9	<i>Nil</i>	Clotted	—	800
2	4.9	1.25	Sour	—	180
3	4.9	1.75	Sweet (?) just souring	4.0	140
E 1	4.0	<i>Nil</i>	Clotted	—	All approximately equal
2	4.0	1.3	"	—	
3	4.0	1.4	"	—	
F 1	4.5	<i>Nil</i>	Clotted	—	800
2	4.5	1.8	Sweet	4.0	560
3	4.5	2.0	"	4.0	48

None of the above samples would keep sweet for forty-eight hours, but those treated with two cubic centimetres of bleaching powder solution and over kept sweet for from thirty to thirty-six hours at room temperature which, at this time, did not exceed 85° F.

The colony counts are calculated with reference to the best total count obtained, i.e., 8,000 organisms per cubic centimetre taken some two hours after delivery of the milk and about three hours after pasteurization.

TABLE II.

No.	C.c. of solution of bleaching powder per 100 c.c. of milk	Condition of milk after 24 hours	Free chlorine after 24 hours (chemically)
G 1	2.0	Sweet	Nil
2	3.0	"	"
3	4.0	"	"
H 1	Nil	Clotted	Nil
2	2.5	Sweet	"
3	3.0	"	"
4	3.5	"	"
5	4.0	"	"
6	4.5	"	"
7	5.0	"	Present
8	5.5	"	"

The room temperature at this time was not above 85° F.

TABLE III.

No.	Infecting organism, and dose per 100 c.c. of milk	C.c. of solution of bleaching powder per 100 c.c. of milk	Condition of milk after 24 hours	Free chlorine after 24 hours	Proportionate numbers of infecting organism recovered after chlorination for—			
					1 hour	2 hours	3 hours	24 hours
I 1	<i>B. typhosus</i> ,	Nil	Clotted	Nil	130	..	..	..
2	10 millions	7.5	Sweet	Present	0	..	..	..
J 1	<i>B. typhosus</i> ,	Nil	Clotted	Nil	100	..	..	..
2	10 millions	7.0	Sweet	Present	0	..	..	..
K 1	<i>B. typhosus</i> ,	Nil	Clotted	Nil	70	..	..	..
2	10 millions	6.0	Sweet	Present	0	..	..	..
L 1	<i>B. typhosus</i> ,	Nil	Clotted	Nil	120	..	..	..
2	10 millions	5.0	Sweet	Trace	0	..	..	..
M 1	<i>B. typhosus</i> ,	Nil	Clotted	Nil	130	..	..	..
2	10 millions	4.0	Sweet	"	0	..	..	..
N 1	<i>B. typhosus</i> ,	Nil	Clotted	Nil	150	..	..	..
2	10 millions	2.5	Sweet	"	0	..	..	..
3	..	3.5	"	"	0	..	..	..
4	..	4.5	"	"	0	..	..	..
5	..	5.5	"	Present	0	..	..	..
O 1	<i>B. typhosus</i> ,	Nil	Clotted	—	..	..	+++	..
2	20 millions	2.0	"	—	..	..	2	..
3	..	3.0	Sweet	—	..	..	3	..
4	..	4.0	"	—	..	..	0	..
5	..	5.0	"	—	..	..	0	..
P 1	<i>V. cholera</i> ,	Nil	Clotted	Nil	+++	..	..	..
2	300 millions	2.5	Sour	"	13	..	..	..
3	..	3.5	"	"	12	..	..	..
4	..	4.5	Sweet	"	10	..	..	..
5	..	5.5	"	Present	0	..	..	..

TABLE III.—continued.

No.	Infecting organism, and dose per 100 c.c. of milk	C.c. of solution of bleaching powder per 100 c.c. of milk	Condition of milk after 24 hours	Free chlorine after 24 hours	Proportionate numbers of infecting organism recovered after chlorination for—			
					1 hour	2 hours	3 hours	24 hours
Q 1	<i>V. cholera</i> ,	2.5	Sour	Nil	70	..	..	0
2	20 millions	3.5	Sweet	"	5	..	..	0
3	..	4.5	"	"	0	..	..	0
4	..	5.5	"	Present	0	..	..	0
R 1	<i>V. cholera</i> ,	2.5	Sour	Nil	89	..	..	0
2	20 millions	3.5	Sweet	"	21	..	..	0
3	..	4.0	"	"	0	..	..	0
4	..	4.5	"	"	0	..	..	0
5	..	5.0	"	Present	0	..	..	0
S 1	<i>V. cholera</i> ,	Nil	Clotted	—	..	..	+++	..
2	10 millions	2.0	"	—	..	..	0	..
3	..	3.0	Sweet	—	..	..	0	..
4	..	4.0	"	—	..	..	0	..
5	..	5.0	"	—	..	..	0	..
T 1	<i>B. Flexner</i> ,	2.5	Sweet	Nil	+++	..	..	..
2	40 millions	3.5	"	"	+++	..	..	..
3	..	4.5	"	"	+++	..	..	..
4	..	5.0	"	Present	+++	..	..	..
5	..	5.5	"	"	++	..	..	..
6	..	6.0	"	"	+	..	..	..
U 1	<i>B. Flexner</i> ,	2.5	Sweet	Nil	++	..	..	0
2	20 millions	3.0	"	"	+	..	..	0
3	..	3.5	"	Trace	+	..	..	0
4	..	4.0	"	Present	+	..	..	0
V 1	<i>B. Flexner</i> ,	Nil	Clotted	Nil	+++	+++	..	+++
2	10 millions	3.0	Sweet	"	170	120	..	0
3	..	4.0	"	Trace	150	117	..	0
4	..	5.0	"	Present	64	1	..	0
5	..	6.0	"	"	13	0	..	0
W 1	<i>B. Gaertner</i> ,	Nil	Clotted	Nil	+++	..	..	..
2	10 millions	2.5	"	"	16	..	..	..
3	..	3.5	Sour	"	25	..	..	..
4	..	4.5	Sweet	Present	25	..	..	..
5	..	5.5	"	"	0	..	..	..

Except in the cases of series "O" and "S," the room temperature for the experiments in the table did not exceed 95° F., but was above 85° F. in the majority of instances.

In the series "O" and "S" the room temperature rose above 95° F.

The same general remarks apply to unpasteurized milk as to pasteurized so far as the chlorination and its results go.

The separation of the cream appears to be perfectly normal both as regards quantity and quality.

In chlorinated milk *Bacillus acidi lactici* predominates almost to the extent of being in pure culture.

No experiments have been made with milk in bulk, the quantities used being either fifty cubic centimetres or 100 cubic centimetres; but, experimentally, it would appear that:—

(1) Milk may be kept fresh by a simple and inexpensive process without any special precautions, the only precaution necessary is that of thoroughly stirring the milk when the bleaching powder solution is added.

TABLE IV.

No.	C.c. of solution of bleaching powder per 100 c.c. of milk	Condition of milk after—							
		2 hours	2 hours	4 hours	6 hours	10 hours	14 hours	16 hours	24 hours
X 1	Nil	Sweet	Sweet	Sweet	Sour	Clotted	—	—	—
2	2.5	"	"	"	Sweet	Sweet	—	—	Clotted
3	3.0	"	"	"	"	"	—	—	"
4	3.5	"	"	"	"	"	—	—	"
5	4.0	"	"	"	"	"	—	—	Sour
Y 1	Nil	Sweet	Sweet	Sour	Sour	Clotted	—	—	—
2	2.5	"	"	Sweet	Sweet	Sweet	—	—	Sour
3	3.0	"	"	"	"	"	—	—	"
4	3.5	"	"	"	"	"	—	—	"
5	4.0	"	"	"	"	"	—	—	"
Z 1	Nil	Sweet	Sweet	Sweet	Sour	Clotted	Clotted	—	—
2	2.5	"	"	"	Sweet	Sweet	Sour	Sour	Clotted
3	3.0	"	"	"	"	"	Sweet	Sweet	"
4	3.5	"	"	"	"	"	"	"	Sour

The room temperature in these cases rose above 95° F.

TABLE V.

Approximately equivalent to—						
C.c. of 1.87 per cent solution of bleaching powder				C.c. of 1.38 per cent solution of bleaching powder		
0.5	0.68	
0.75	1.02	
1.0	1.35	
1.2	1.66	
1.3	1.79	
1.4	1.92	
1.5	2.08	
1.75	2.37	
1.8	2.48	
2.0	2.70	
2.25	3.02	
2.5	3.38	
2.75	3.70	
3.0	4.05	
3.5	4.72	
4.0	5.4	
4.5	6.07	
5.0	6.75	

TABLE VI.—Un-PASTEURIZED MILK.

C.c. of solution of bleaching powder per 100 c.c. of milk	Condition of milk after—						Total colonies per c.c. one hour after chlorina- tion on agar at 37° F.
	4 hours	5 hours	6 hours	12 hours	14 hours	24 hours	
<i>Nil</i>	Sour	Sour	Clotted	..	..	..	..
2.5	Sweet	Sweet	Sweet	—	—	Sour	..
3.0	"	"	"	—	—	"	..
3.5	"	"	"	—	—	"	..
<i>Nil</i>	Sweet	Sweet	Sour	—	—	Clotted	..
2.5	"	"	Sweet	—	—	"	..
3.0	"	"	"	—	—	Sour	..
<i>Nil</i>	Sweet	Sour	Sour	Clotted	—	—	..
2.5	"	Sweet	Sweet	Sweet	Sweet	Sour	..
3.0	"	"	"	"	"	"	..
3.5	"	"	"	"	"	"	..
<i>Nil</i>	Sweet	Sour	Sour	Clotted	—	—	..
2.5	"	Sweet	Sweet	Sweet	Sweet	Clotted	..
3.0	"	"	"	"	"	"	..
3.5	"	"	"	"	"	"	..
4.0	"	"	"	"	"	Sour	..
<i>Nil</i>	—	—	—	—	—	—	1,320,000
2.5	—	—	—	—	—	—	650,000
4.0	—	—	—	—	—	—	700,000
<i>Nil</i> *	—	—	—	—	—	—	70,960,000*
2.5*	—	—	—	—	—	—	16,560,000*
4.0*	—	—	—	—	—	—	9,830,000*
<i>Nil</i>	—	—	—	—	—	—	3,428,000
2.5	—	—	—	—	—	—	2,162,000
3.0	—	—	—	—	—	—	1,130,000

The room temperature in these cases rose above 95° C.

* All other samples except this one were dealt with within some two hours of the time of the finishing of milking and within an hour of the normal hour of delivery to customers; this sample was delayed two hours beyond this time.

(2) Milk treated by this method is not appreciably altered as to taste or fat content after allowing time for the action of the chlorine. I am unable to state what happens to the vitamins, though there does not appear to be any reason why they should be affected.

(3) Infected milk may be rendered safe for consumption. The most commonly surviving organisms are *Bacillus acidi lactici* and *B. lactis aerogenes*.

It also appears that the resisting powers of different pathogenic organisms towards chlorine differs very considerably, the dysentery group organisms being particularly great in this respect.

I have not been able to trace any literature on this subject.

I wish to thank Major M. C. Beatty, R.A.M.C., D.A.D.M.S. (Sanitary), Peshawar District, for his advice, and Assistant Surgeon J. P. McGuire, D.C.M., I.M.D., for his help with several of the experiments.

NOTES ON ALASTRIM IN JAMAICA.

By MAJOR W. F. M. LOUGHNAN, M.C.

Royal Army Medical Corps.

THE disease has many synonyms, and has been described under various names in different countries. In South Africa it is known as *amaas*, *Kaffir-pox*, *milk-pox*, *sanaga-pox* and *varioid varicella*. In South America and the West Indian Islands it is known as *alastrim*, *epidemic vario-varicella*, *milk-pox*, and *West Indian modified small-pox*.

The origin of the word "*alastrim*" is probably derived from the Portuguese verb, "*alastrar*," which means "to strew, or cover all over." This nomenclature of the exanthem originates from the prevalence of the malady in Brazil.

The disease has been differentiated as a separate entity for some years. One of the earliest accounts of the exanthem was given by Anderson, in 1866, of an epidemic that occurred in Jamaica in the previous year. Dickson and Lassalle described an epidemic of the disease as seen in Trinidad in 1903. Seheult has also written on an outbreak that occurred in Trinidad from 1902 to 1904. Outbreaks of an anomalous varioid disease were reported from Cambridge in 1903. Ribas, and later Aragao, gave lucid accounts of the disease as observed in Brazil, where 250,000 cases of the exanthem had occurred.

Ribas was of the opinion that the Brazilian disease was not a true small-pox, but identical with *amaas*, or South African milk-pox, for the following reasons:—

(1) Its mortality being as low as 0·5 per cent, whereas the usual mortality from small-pox under similar conditions is 30 to 60 per cent.

(2) The absence of secondary fever.

(3) The absence of a characteristic smell of small-pox.

(4) The non-occurrence of deep scars.

(6) The short duration of immunity against *vaccinia*, owing to its being possible to vaccinate the larger proportion of persons who have suffered from the disease, within six months if necessary.

Armstrong has reported an outbreak of 1,000 cases of small-pox from Sydney, New South Wales, in 1913, with one death (that of a parturient woman who died some hours after delivery), and he concluded that the disease was identical with the epidemic disease known as *alastrim*, *milk-pox*, etc., which had been reported from various parts of Central and South America. Armstrong's account of the clinical nature of the epidemic corresponds with the description of the Brazilian *alastrim*, as regards the low mortality, absence of secondary fever, non-occurrence of deep scars; but in the Australian disease the typical variolous odour was noticed in the severest cases. The epidemic was too small for observation to be undertaken as to the duration of the subsequent immunity to *vaccinia*.

Monckton Copeman investigated a variolous-like outbreak in Norfolk and Suffolk in 1919, which was supposed to have been introduced from the Mediterranean. This disease was of the nature of small-pox, but seemed to resemble more closely Brazilian *alastrim* than any other form of *variola* met with in England.

Etiology.—Like *variola* and *varicella*, very little is known about the etiology of *alastrim*. It may be a small-pox modified by racial immunity, or it may be a

more severe type of varicella. At present alastrim would clinically appear to occupy a mid position between small-pox and chicken-pox.

Period of Incubation.—Only in a few cases was it possible to accept the statements of the patients as to the exact date of their exposure to the infection, so as to determine the incubation period of the disease. From careful investigation as to the number of days that elapsed between the date of exposure, and the manifestation of the first subjective, or objective sign of the exanthem, it was found to vary from nine to fourteen days, and average about twelve days for the period of incubation.

Dissemination.—Alastrim is spread by actual contact from person to person, by air, clothing and other fomites. It is possible that the exanthem can be carried by flies, through the contamination of their feet, or by inoculation of the cutaneous system, through recent contamination of the suctorial proboscis in the case of blood-sucking insects.

Alastrim appears to be more infectious during the stages of pustulation and desiccation. One case that came under my observation, in which the statement of the patient could be absolutely relied upon, was that he had passed through an infectious ward where patients were undergoing treatment for alastrim, and he developed the disease in exactly nine days.

Early Symptoms and Initial Fever.—The onset may be either abrupt or somewhat delayed, or again, the prodromal symptoms may be entirely absent. When the prodromata are abrupt, the patient may suffer from prostration, severe pains in the head and back, anorexia, and nausea. Headache appears to be more common than backache. Indefinite pains in the bones, joints and muscles are frequently present. The mouth, soft palate, and tonsils are hyperæmic, but a sore throat is not always evident as an initial symptom. A bronchial catarrh is often observed. The temperature is elevated from 102° to 105° F., and the pulse is increased in proportion. No initial rashes are noted.

Papular Stage.—The primary temperature, which varies in individual cases from 102° to 105° F., lasts for three or four days, and rapidly falls to normal on the appearance of the papular eruption. The rash first appears as small papules, and may continue to develop with some sequence for a few days. The papules are small, somewhat raised, slightly irregular in shape, and not surrounded by any red areola, or shotty on palpation. The eruption first appears about the head or neck, then on the upper extremities, abdomen, back, and lower extremities. When the fever subsides, and the papular rash appears, patients begin to feel much better, and not infrequently complain of hunger, and state they are free from all discomfort.

Vesicular Stage.—In about thirty-six hours the papules pass to the vesicular stage. This vesicular condition lasts about two to four days. The vesicles are round at the margin, non-umbilicated, non-septate, and somewhat flattened; but there is a tendency to dome-like formation during this stage. They mature irregularly, and after forty-eight hours the fluid begins to become whitish in colour. Towards the end of this stage the vesicles become tense, and a period of subcutaneous œdema is often present, best marked on the head and face, and to a lesser extent all over the body. This causes general discomfort, almost amounting to pain, which begins to disappear about the seventh day.

Pustular Stage.—Pustulation begins from the fifth to the seventh day, or

even later. During this stage a secondary fever may be present, which appears to vary with the severity of the infection; in mild cases the fever may be entirely absent. From about the seventh day, the pustules become inspissated, and the

NOTES ON DIFFERENTIAL DIAGNOSIS OF SMALL-POX, ALASTRIM AND CHICKEN-POX.

Variola	Alastrim	Varicella
Formerly a disease of childhood, but occurs later in well-vaccinated communities	Mainly attacks adults	Mainly a disease of childhood
Readily inoculable	Inoculable with difficulty	Inoculability, doubtful
<i>Incubation</i> .—About 12 days	<i>Incubation</i> .—12 to 14 days	<i>Incubation</i> .—10 to 19 days (Caiger)
<i>Prodromal Illness</i> .—Usually severe	<i>Prodromal Illness</i> .—Occasionally absent, but may simulate small-pox	<i>Prodromal Illness</i> .—Often wanting
<i>Eruption</i> .—Fully out in 36 to 48 hours.	<i>Eruption</i> .—Comes out usually in successive crops over period extending to ten days or even more	<i>Eruption</i> .—Comes out in successive crops over a period of 3 to 5 days or more. Development of vesicles is so rapid that papules may escape observation
<i>Vesicles</i> .—Not fully-formed till third or fourth day of rash. Induration of base: umbilicated, multilocular, so do not collapse completely when pricked.	<i>Vesicles</i> .—Mature irregularly-unilocular, not umbilicated. Covering layer of epithelium thick, so when pricked may not collapse completely as in varicella vesicles, may form bullæ which on rupture leave large denuded moist surfaces	<i>Vesicles</i> .—Fully developed in 2 days. Unilocular, usually not umbilicated, walls collapse when pricked and clear fluid escapes. Vesicles may form bullæ which on rupture leave large denuded surfaces
In a circumscribed area, pocks attain coincidentally same stage of development		<i>Scabs</i> .—Separate in a week or 10 days
<i>Distribution</i> .—Specially copious on face and extremities	<i>Distribution</i> .—Often first on trunk and chest, subsequently comes to resemble small-pox rather than varicella	<i>Distribution</i> .—First on trunk; eruptions more copious on trunk, thighs and upper arms than on face, scalp or extremities. Pocks in all stages of development may be detected side by side. Palms and soles not affected
<i>Temperature</i> .—Falls rapidly with appearance of eruption, rises again if pustular stage well marked	<i>Temperature</i> .—May rise to 100-104°, but secondary rise is rarely observed	<i>Temperature</i> .—Rises to 100-102° with each successive crop of vesicles—pyrexia, irregular
	Patients never so ill as might be anticipated from extent or confluence of eruption, which after first day or two is quite disproportionate to constitutional disturbance	
	<i>Mortality</i> .—Very small, 0.5—1.0 per cent	
<i>Vaccination</i> .—Protects, the more so the more efficiently and recently (up to a few weeks beforehand) it has been performed	<i>Vaccination</i> .—Protects, but not to the same extent as in small-pox. Effect of recent (but not too recent) vaccination well-marked. Occasionally re-vaccination during convalescence may prove successful	<i>Vaccination</i> .—Does not protect

central dome-like covering assumes a depressed appearance. Maturation proceeds rapidly, and some of the scabs become detached about the fourteenth day. This stage may be prolonged, particularly in such areas as the palms of the

hands and soles of the feet. Marked pitting or scarring does not occur, but if any is present it is slight, and in no way resembles that seen in small-pox. Pigmented spots are commonly seen on the skin following the disease. The slight scarring and the pigmented areas remain for some time, but eventually disappear.

The Distribution of the Eruption.—The eruption is general, but is commonly seen in certain situations first, notably on the neck, face, chest, and upper part of the abdomen respectively. The scalp, face, forearms, wrists and back are often heavily affected. The palms of the hands and soles of the feet suffer severely, and maturation is often prolonged in these regions. The upper arms escape lightly, as a rule. All the extensor surfaces appear to be more severely attacked than the flexor aspects. The mucous membrane of the mouth, soft palate, and throat are also affected. The rash is discrete all over the body, but on the upper part of the head, patellar, and anterior tibial regions, the rash is often confluent in character.

Complications and Sequelæ.—The common complications met with in this disease are conjunctivitis, laryngitis, bronchitis, and adenitis. As sequelæ to alastrim, boils, superficial abscesses, and asthenia have been observed. Any pre-existing morbid condition such as cardiac, pulmonary, renal, or hepatic disease, may alter the prognosis as to recovery. The mortality in this disease is extraordinarily low, being variously given in different epidemics as from 0.5 to 2 per cent.

Differential Diagnosis.—Alastrim has to be differentiated from small-pox, chicken-pox, vaccinia, and syphilis.

Monckton Copeman gives the preceding diagnostic table of small-pox, chicken-pox and alastrim.

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Travel.

THE LAND OF CREAM AND — ?

By MAJOR R. C. WILSON.

Royal Army Medical Corps.

You are quite wrong—it is not Devon, but very many miles due East. If Devon is anything like this place I don't want to see it, for I am sick of cream. Cream for your breakfast, lunch, tea, and with any other meal you like to take, until breakfast time again. It is universally served in one form, i.e., Schlagsahne, turned into English, whipped cream. You can't get away from it. Even that horror of horrors to which we give the polite French name—"Blancmange" turns out here to be a delicious confection made with cream. Ice creams are not the frozen custards we know so well, but are the real article. If you go to a "Conditorei" to tea and you stroll to the long table laden with umpteen varieties of cakes and choose what you think would suit the inner man, if you are not quick enough and have a strong presence of mind, the presiding "deity" will slap a small shovelful of cream on your cake and you will have to dig for it afterwards with a spoon. In addition to this the ordinary visitor orders from one to four extra portions of the stuff. I have hardly tasted real cream since before the War; but now I have eaten enough to last me until the next one. The amazing part of it all is that the sale of cream is "verboten." Enough of cream! I will tell you how we found it.

I got a month's leave and with a family of four all told it would cost about £30 return to go home—although Rhineland is a home station. Some nice German friends of mine chanted the praises of a certain place called Westerland in the Island of Sylt. The island is in the North Sea about ten miles west of Denmark. They were going there anyhow, so we decided to follow.

We took the night train to Hamburg with sleepers and arrived there next morning at 8 a.m. The special Badenzug for Westerland left at 9.30, so we had ample time for breakfast. This we had at the Berliner Hof near the station. The Ober took us in charge at once and gave us a private room and made such a fuss with the Kellners that instead of one breakfast we were served with two—of course one was returned to store. Everyone was most polite and we were treated almost as royal personages. From here there are three ways of getting to Sylt—one by train, one by the Hamburg-American steamships via Heligoland, and the other by aeroplane—two planes there and back each day. The train journey was over rather monotonous flat country, mostly cultivated with potatoes, beans, etc., and enormous stretches of pasture land. On arriving at the Danish

frontier we were held up for about an hour while the Danish officials solemnly tied up the carriage doors with pieces of string and then with an instrument which strongly reminded one of the Spanish Inquisition punched lead seals on the aforesaid pieces of string. The only inconvenience was that people who wanted to get out went through the window instead of the doors. After seeing the country I decided to remain in the train. I could not imagine anyone wanting to leave a nice stuffy train for a country like that. Arriving at Hoyer-Schleuses we had all to bundle into a large waiting-room—not a single porter—so we had all to “hump” our hand baggage as best we could. In the waiting-room we were all locked up to await the arrival of the Sylt steamer which turned out to be an hour late. There was a long buffet laden with good things such as beer, sandwiches, etc. Not a single German approached it, which I could not understand, as Germans cannot resist such things. After three quarters of an hour—being very “fed up” I decided to have a bottle of beer, so approached the beautiful lady in charge and timidly gave my order. She said “Yes, but the price is so much.” A roar of laughter went up from the audience and then I realized that Danish prices were charged. The price was about eight times more than in Germany. I did not want to “show off,” so blushed, murmured “no thanks,” and retired to my corner.

The sea journey to Sylt was extraordinary ; you went for miles through a tortuous avenue of broom-sticks—you could see this avenue for miles ahead. When the tide is out it is all mud. A short journey in a very small train brings you to the capital—Westerland. The town has been built as a seaside resort and is not of the converted village type one so often sees at home. Good hotels, restaurants and first-class rooms.

The island is about forty kilometres long with a beach of the same length facing due west. The east side is nothing—only a series of mud flats. An old “tarry breeks” told me that the fishing was very good. After watching several people’s efforts I decided to take his word for it and go home and leave all the fish to him. It is an extraordinary fact but the old proverb ought to be changed to “the nearer the sea, the fewer the fish.” In Cologne, hundreds of miles from the sea, fish of every kind is more plentiful and cheaper than in this island in the middle of the North Sea. The beach, following the usual continental practice, is divided up into sections: One place where you are allowed to pitch your camp in the form of a gigantic basket chair and dig yourself in to your heart’s content—construct castles, forts, “dug-outs” etc., and leave the onlookers guessing whether you are in your first or second childhood; another section in which it is strictly verboten to put a spade in the sands; the sanctum of all—the bathing beach. Here you must pay the large sum of ten marks to approach, be in possession of a Kur ticket and enter through a special gate. An American visitor did tell me a method of getting in for nothing but the mental strain was too much and besides ten marks is less than a penny. Here there are no such out-of-date contraptions in England called “bathing

boxes." There is a miniature town behind the bathing strand with nearly one thousand properly constructed dressing rooms. In the centre is a big square of sea-sand, where, after your bath, you can loll and take a sun bath and show off your latest creation of bathing costume or pyjamas, or admire some one else's. Attendants supply you with light refreshments in the form of port wine, chocolates, etc. The usual continental custom obtains in the bathing place. Two men in a movable pulpit on wheels superintend the bathing, and if anyone wanders from the flock a few toots of a horn and a wave of a bâton brings the erring one back to the pack. Individual swimming is not encouraged and if anyone was foolish enough to wander and get drowned he would be very lucky if he got off with less than six months hard. The result is people are frightened of getting drowned in Westerland. The restaurants are good—some equal to the Savoy in London—minus the price. The best is the Strand Kur Haus. This we made our headquarters and after a sharp and serious argument with our hotel proprietor, who was not a German, on the matter of a 30 per cent. tax on foreigners—we left him and went to rooms, and fed in the above restaurant and paid no taxes at all. The manager was kindness itself and gave us the best table overlooking the sea. This table was reserved for us whether we were there or not. The people were much more kind to us than in the occupied area and I was known all over the place as the "Herr Major." We got to know a number of nice German families and had the time of our lives. It is supposed to be the Deauville of Germany. The ladies' costumes were not bad but fell very short of the French creations. The men's idea of a seaside costume was deplorable, I simply can't describe them—the colour schemes of their jumpers would make the members of a medical students' hospital cup-tie "rag team" turn green with envy. Gambling is of course verboten, still you can play baccarat, roulette of sorts, as long as your money lasts. Oysters grow on the premises. I have always stuck to the rule of only eating them when there is an r in the month. I could not find an r in July anyhow, still, I had oysters most mornings at 11 a.m. and jolly good they were washed down with a pot of real Pilsener beer; cost about tenpence a dozen.

An excellent band was provided by the town which played good music three times a day. In the evenings you had your choice of half-a-dozen carabets where you could dance to your heart's content. Competitions of all sorts, such as the best dancer—the most beautiful dress, and on one occasion the best looking man—another man won the prize. One nice man stands out above all others—one Herold—a photographer who owns a fleet of henchmen in mustard-coloured pyjamas who are willing to take your photograph when and where you wish. He is an inhabitant of the place, and will give you all information about everything connected with the island. There are no "trippers" as it is too far from anywhere. No nigger minstrels. The people are very orderly, and I never once saw the sign of drink on anyone. There is a police force—I know there is because

I saw *him*. He was posting up a new *verboten* placard and seemed to be very pleased with it. They say he has done no work for years, and if anyone transgressed or disregarded one of his sacred "*verbodens*" he would be at his wits' end to know what to do. I asked my landlady for a latch key, but she said it was not necessary as the door was open day and night. There is a wonderful indoor bathing establishment run by the Stadt, where you can have every kind of bath you wish from a Turkish to the latest electrical one. I went there once and ordered a hot salt water bath. The lady in the ticket office asked me if I wanted a massage ticket as well. I said "Yes." I was enjoying my bath when in came a female and said the German equivalent for "excuse me" and filled a jug from the fresh water tap of my bath. I was shocked but recovered. After ten minutes a buxom female of over forty summers and many kilos came and removed me from my bath—dried me and put me on the operating table. I had the best massage I ever had in my life, and she did not even forget the final slap, slap, to indicate that the operation was over and the next victim might approach. I have no hesitation now in making a voyage to Japan. It was the most bracing place I have ever been to and we enjoyed every moment of our stay. The weary journey back to Hamburg via Denmark was a thing we dreaded. This was solved by getting to know the chief aviator—an ex-German flying officer, of the German air line. We hired the whole aeroplane at a cost of under £4 and flew the 200 kilometres across the North Sea to Hamburg. Time—one hour and ten minutes instead of nine hours by train and ship. We arrived in Hamburg in time for lunch and afterwards explored the best imitation of Venice there is. We got the night train with sleepers to Cologne and arrived there next morning to time.

We and another English family from Cologne constituted the English colony in Sylt. The people were most kind and did everything in their power to make our stay pleasant. I went to the local bank to see if they would change a cheque; the manager asked me who I was, and when he heard I was an English officer would not even look at my passport, but gave me as much money as I wanted.

Another blessing—there are no tips. Everything you order, whether it be a glass of beer or your hotel bill, has ten per cent added to it and that is the end of it. In the hotel you tip the chambermaid and no one else. You leave the hotel like a gentleman and no one sees you off but the manager. It makes you almost like living in a hotel. The total cost of a month's stay for four people, living like princes, including the aeroplane home, was under £50.

I hope to return there some day.

Lecture.

THE OUTLOOK IN TROPICAL HYGIENE.¹

By ANDREW BALFOUR, C.B., C.M.G., M.D., B.Sc., *Director-in-Chief,
Wellcome Bureau of Scientific Research.*

I HAVE chosen this subject because it will enable me to say something about the practical application of our existing knowledge to the problems of hygiene and sanitation which confront us, a matter with which I trust this Institute will soon be intimately concerned.

The future of tropical hygiene depends upon research. Such a statement is doubtless a truism, but I fear its truth is, even in these days, not fully appreciated. Just as in the treatment of disease empiricism has often exercised a baneful influence, so in its prevention measures have from time to time been applied based on no sure foundation, and the result has been disappointing both from the hygienic and the administrative standpoint. Take, for example, the long-continued use of lime juice as a prophylactic in scurvy. Countless gallons of this beverage have been consumed, chiefly by soldiers and sailors, and though doubtless some benefit has accrued, for it contains a modicum of anti-scorbutic vitamine, yet recent research has shown that our faith should have been placed in the kindred lemon juice, which was the substance originally introduced into the Navy for combating the fell disease of sailing ships, but for which the juice of the lime was substituted, probably without thought and certainly without sound scientific approval.

Again, consider how much time and money has been spent on so-called disinfectants. Long ago, when working in Cambridgeshire, I used to be amazed at the liberal distribution of tins of disinfectant to households plagued by diphtheria and enteric fever. Even then I used to wonder what possible service they could render beyond camouflaging the odour of some privy midden, but they were received with thankfulness and, possibly, even employed. It was not until Barlow, in 1910, raised his voice and testified against some of the absurdities of fumigation and the indiscriminate use of evil-smelling powders and equally malodorous fluids that the general belief in such measures was shaken. Yet even now, despite the careful observation of Walcott and Curtis in the United States and the mass of evidence which has accumulated, there are high priests of fumigation who burn sulphur upon the altar of hygiene and strew disinfecting powders broadcast as did others in the Middle Ages.

Pray do not think that I wish to decry the value of disinfection and of disinfectants. I fulminate merely against the unwise use of the latter, the tendency to disregard the rôle of the patient and his immediate surroundings in spreading infection and to forget, more especially in the tropics, the value of fresh air and sunlight as microbicidal agents.

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Empiricism dies hard and it is strange how slowly scientific knowledge spreads, even in the presence of an all-powerful Press and when the facilities for the diffusion of information have increased a thousandfold.

But recently a gentleman in Mauritius gravely assured me that the appearance of malaria in that island coincided with the introduction of guano from South America and that this fever was undoubtedly due to the pernicious habit of manuring the cane fields with the dung of petrels and of penguins.

Another, interested in the failure of the sewers of Port Louis to function in an efficient manner, a failure due to a faulty fall and deficient pumping power, seriously suggested that all would be well if, by a solution of soap, the interiors of the pipes were well lubricated in a manner similar to that employed by the fashionable physician for the treatment of constipation.

One may pardon the laity, for apart from the lack of training, they suffer because Medicine has so often spoken with an uncertain voice. Theories have taken the place of facts, and, while it would be a sad world without theories, a world ruled by them would become a place to excite the compassion and lachrymation of angels.

Still, there can be no doubt that amongst civilized and enlightened communities great progress has been made and the man in the street can generally discuss in an intelligent manner the ætiology of the chief communicable diseases to which he is likely to fall a victim and has some acquaintance with methods of prevention and cure. In short, education has now reached such a stage amongst the inhabitants of most countries in the temperate zone that it may be truly said of them they live to learn, the while they learn to live.

Very different, however, are the conditions in the tropics. Though in many places there has undoubtedly been an awakening of late years, native populations, as a whole, still grope blindly under a pall of ignorance and superstition, and the most pressing need in all matters concerned with their sanitary progress is education. Such education, however, must be on right lines. In several of our Colonies I have found the catechism system in force. I was myself reared upon a certain Shorter Catechism, to which have been attributed remarkable virtues, and to the retention of which, when England discarded it, the surprising development in Scotland is said to have been due. Hence I have no quarrel with the catechism system provided it is properly employed. I grieve to say the health catechisms I have seen in use have not been so employed. Remember they do not deal, like the Shorter Catechism of the Assembly of Divines at Westminster, with abstruse conundrums admirably fitted to constitute a course of mental gymnastics. That Catechism, I take it, apart from inculcating sundry religious tenets in a logical manner, provided, if carefully expounded and explained, a course of mind training which its advocates pronounce second to none. It is, however, inconceivable that the Shorter Catechism should ever be illustrated, or that, even if it were illustrated, its usefulness would be enhanced. On the other hand, what the health catechisms require is graphic exposition.

More than once I have asked a little black or brown girl to tell me what she knew about ankylostomiasis. With hands clasped behind her back and her eyes fixed apparently on the future of hygiene, she has faithfully recited her catechism and recounted all about the hookworm, from the larva penetrating the skin to the adult female laying eggs in the intestine. But when I came to ask her what

an ankylostome was like she was completely at sea and had no idea as to whether it equalled in length an earthworm or an anaconda. Rarely, very rarely, have there been diagrams or pictures to aid the childish mind. Even these, helpful though they be, are not sufficient. What is really required is the provision of models, and when it can be managed, demonstrations from Nature itself. This latter method is not new. You may remember that it was employed by Mr. Squeers at Dotheboys Hall in "Nicholas Nickleby." One pupil was made fully acquainted with what Mr. Squeers called the "winder" by being made to clean it, while another gained familiarity with what his master termed "bottinney" from being forced to weed the school garden.

Coming to more recent times, many of you must recall the Sanitary Demonstration Centres which were established on all the fronts during the war and proved both stimulating and educative. Something of this kind is wanted in connexion with schools in the tropics wherever a serious effort is being made to inculcate the principles of hygiene. It should neither be difficult nor expensive. In many cases the pupils themselves could make the simple models showing how latrines and incinerators should be constructed and how grease traps and soakage pits may best be fashioned. I am glad to say that the necessity for graphic exposition has been recognized in the schools at Accra on the Gold Coast.

The cinematograph should be summoned to our aid. So far I have only heard of three good sanitary films. They are the rat film, "Swat the Fly," and "Unhooking the Hookworm," the latter two, I need hardly say, being American productions. I have seen them and they are excellent, though both might be better adapted to tropical needs.

There is great scope for a really good film on plague. We know much about plague and can combat it upon sound lines, but it is exceedingly difficult to get native populations to co-operate with the sanitary authorities in campaigns against rats and fleas. They are indifferent or actively hostile, but their attitude is very largely to be explained in terms of ignorance. Educate them, especially when young, and the difficulties will gradually disappear. The matter is well summed up by Mendelson in his recent account of plague at Bangkok.

He says: "The only conclusion the author can come to is that education, though an extremely slow proposition, is, after all said and done, the only possible way of impressing the people and producing permanent results. Practise a wise conservatism, have unlimited patience and perseverance, combined with an absolute faith in the righteousness of your cause, and in the distant future there will dawn a ray of sanitary light, that if properly nursed may even develop into a bright star."

His astronomical simile is not, perhaps, too happily chosen, but his meaning is clear and all with sanitary experience of the tropics will assuredly agree with him.

At the same time in certain directions immediate active work will bring about rapid results, apart altogether from the question of educating native communities, and immediate active work is required, for people are dying and there is a great load of sickness and inefficiency.

These remarks anent education have been rather in the nature of a digression, though one, I believe, amply justified by the importance of the subject.

Let us, however, now hark back to the question of research on which so much

depends. I need scarcely remind you that this country was once foremost in the field. The work of Manson and of Ross, the investigations of Bruce, the findings of Leishman, the labours of the Plague Commission in India, the successful inquiries of Fraser and Stanton, the discoveries of Sir Leonard Rogers, the researches of Low and Leiper and many other British achievements will at once occur to you. I fear, however, that at the present time we scarcely occupy the same position that we did. In some ways this is only natural. The French, a great nation where science is concerned, have long been friendly rivals; for a time, the Germans with dogged persistence wrested secrets from the tropics, and though as a colonizing power, Germany has ceased to exist, her workers are still in the field and she is turning her attention to new spheres of activity. The two nations, however, which so far as research into the more *practical* side of tropical hygiene is concerned, appear to be outstripping us, are Holland and the United States. They are not doing so because they have better men, but because they have at their command resources which we are denied and also because they work in some ways on better lines.

It is scarcely to be expected that, at a time like the present, our Governments can find large funds for developing research in the tropics, though it is always good policy to cast the sprat and secure the salmon, but, at least as far as the United States are concerned, a great deal of the money which has been spent of late years has come from private sources. As a nation we may be poor, thanks to the fact that, as of yore, we have saved Europe, but it would appear that there must be many individuals who possess more money than they can well spend. The wealthy American frequently endows research. As Mr. Wickliffe Rose of the Rockefeller Foundation said to me the other day, and he should know, "there is far more fun," that is the way he put it, "there is far more fun to be got out of spending money for the betterment of mankind than in any other way." If only our British plutocrats would combine to furnish the sinews of war what fun they might have and what might not be accomplished! Apart altogether from the mere loss of life, the lack of efficiency, the labour shortage, the interference with trade, the waste and worry brought about by tropical maladies and more especially epidemics, think what they connote in the way of sorrow and misery and wretchedness!

Not long ago I saw an old Indian woman weeping bitterly because her son, her sole support in life, had perished because of plague. There are many diseases due to the ordinary wear and tear of life from which mankind may die more or less comfortably, and we may become, perhaps, somewhat resigned to such departures, for they are, to a large extent, inevitable so long as the human body is a machine. It is, however, a totally different thing when young lives and useful lives and lives which mean much to others are surrendered at the call of parasites which we know we can defeat if only means are forthcoming. We deal in a summary fashion with human parasites which prey upon society and on our hoarded wealth, but we are still somewhat callous as to the ravages of bacteria, protozoa and helminths amongst the inhabitants of our colonies and dependencies.

I think if only the wealthy in the land realized the burden of distress and inefficiency which exists and were assured that much of it could, with their assistance, be alleviated and indeed abolished, their purse strings would be loosed

and the one International Health Board supported by a Rockefeller would have its counterpart on this side of the Atlantic, to the benefit of humanity and the glory of the Empire.

The comparison with Holland is perhaps scarcely fair, for the Netherlands is a small country blessed with large and exceedingly rich colonies, but the Dutch, a thrifty folk, have discovered that to get the best out of these colonies they must make them healthy and keep them healthy, and anyone who has studied their activities in Java and Sumatra will agree that they are working to good effect.

I have said that both Holland and the United States appear to proceed on better lines than we do. For one thing they are quicker to apply the knowledge gained than we are, a point to which I will allude immediately; for another, so far at least as the Americans are concerned, they give their research workers a fair chance.

In our possessions we establish laboratories, though even now there are not nearly enough of them, but we are apt to understaff them in a vain effort at economy and we swamp the scientist with routine work.

Instead of being able to concentrate on some promising proposition he has to examine specimens from hospitals and private sources, he has to undertake sanitary examinations of all kinds of water, food, and so forth. All this is very necessary and useful, but from a research point of view it is wasteful and unwise. There is some reason for thinking that the true research worker, like the poet, is born, not made. There should be a niche for him in every large tropical laboratory and he should be left alone to prosecute his special work. This spells money, another reason for my appeal to the plutocrats, but it also spells progress. It is along such lines that the Americans work and the results are apparent. They concentrate on a problem and when they have solved it they apply the knowledge gained. When we have acted on the first of these principles our efforts have been crowned with success. Ross, at Manson's instigation, concentrated, so far as a niggling Indian government would permit, on the mosquito-malaria problem and revolutionized our conceptions. Bruce, thanks to the aid of the Royal Society, concentrated on Malta fever and lifted the veil of mystery which enshrouded it. Again he took a microscope to Zululand and proved that Livingstone was right in his conjectures about nagana and the tse-tse fly. Finally he and others, devoting themselves to the problem of sleeping sickness, speedily shed light on dark places.

It is true that the harassed general worker has at times made great discoveries. Laveran was a busy army surgeon when he revealed the parasite of malaria; Manson, the Master, who has recently passed to his well-earned rest, was a private practitioner when his classical researches on filariasis were accomplished, but it must be remembered that the struggle becomes more intense, that there are, nowadays, greater distractions. Moreover the superman is rare.

Another point worthy of consideration is the nature of the research work conducted. A vast deal is accomplished which has not much practical value. I am not one of those who think that science should work solely or even mainly towards utilitarian ends. Pure science, as it is sometimes called, true science, as it might well be renamed, knows no boundaries, and moreover one can never tell what bounties may result from its pursuit.

As Professor Fleming has said in his "Fifty Years of Electricity": "If we

could have peeped into the laboratories of the Royal Institution in Albemarle Street, London, in the autumn days of 1831 and seen Faraday busy with his magnets, copper wire and discs and iron bars we might have wondered that so much time and intelligence were not better bestowed. But, as we have seen, these epoch-making experiments have rendered imperishable service to humanity."

Looking back, however, on the history of research in tropical medicine and hygiene there is evidence that the best results have been secured when the worker has directed his energies towards a definite goal and has had in mind some concrete advantage to be gained as the result of his labours. Moreover there is pressing need for research in certain directions which we know will prove fruitful. Apart from the fact that we wish to benefit humanity and aid the development of the Empire, it must be remembered that we are judged by what we accomplish. The lay administrator, the man of wealth, may not be impressed by the solution of some abstruse problem of high scientific value, but he is quick to note some discovery which he sees may have far-reaching results on the welfare of a country or the advance of commerce. Hence, so far as possible, it is well to be practical and to work on remunerative lines.

There is another aspect to this question of the nature of the work to be followed. It suffers from lack of inspiration and co-ordination. There are two kinds of research worker. The rarer is the brilliant man gifted with ideas of his own which he is capable of transmuting into facts, the commoner, he who, lacking in imagination, is yet, thanks to his technical skill, powers of industry, capacity for logical deduction and well-balanced judgment, able to work out some thought suggested by another, to prove an hypothesis possibly advanced by someone quite unable to establish it experimentally, to unravel the confusion of some fine but faulty conception.

We need both classes, though, of course, the first type of mind is worth much fine gold, for it is akin to genius. It is the case that men stumble on mighty truths. Chance plays a part in scientific work as elsewhere, but, as a rule, it is only by hard thinking and hard work that results of any moment are achieved. A man must be given time to think: another reason why the scientist should not be overwhelmed with drudgery.

When some new method has been evolved or new truth established how often do we say, "Why in the world did we not think of that ourselves?"

A recent example may be culled from hookworm investigations. Until Baermann, in Sumatra, devised in 1917 an apparatus whereby hookworm larvæ could be isolated from considerable quantities of soil no one had taken up the matter, and yet it is one of great value, for not only does it enable one to study the activities of the ankylostome in the soil, but it makes it possible to determine accurately the source of infestation with hookworm disease in any region. Baermann's pioneer work in this direction has proved of great service to the American investigators in Trinidad. Again some of these latter, Ackert and Payne to be precise, conceived the idea of studying the rôle played by the domestic pig as a disseminator of the human ankylostome, and they have shown that this animal is an important factor in spreading broadcast human hookworm eggs.

It is curious and unfortunate that these ideas did not occur long ago to British

workers, many of whom have been much more in touch with ankylostomiasis than the American observers, although it is true that quite recently O'Connor, in the Ellice Islands, and Legg and Rheuben in Queensland described ankylostomes in pigs. However, this is often the case. A man brought into contact with an unfamiliar condition is more likely to emit fresh ideas regarding it than one whose perceptions have been blunted by close association with it. To this aspect of the case further reference will be made from rather a different standpoint.

It must not be thought that I wish to decry the work which is being done in British laboratories. I need only mention the careful and successful investigations of Dr. and Mrs. Connal, at Lagos, on the transmission of *Loa loa* by biting flies of the genus *Chrysops*, the manifold activities of Macfie at Accra, the fact that Archibald, in the Sudan, has traced a form of splenomegaly to bacterial infection, and that Scott, in Jamaica, elucidated the mystery of vomiting sickness, to show that we are by no means decadent. Further, have not Stanton and Fletcher, at Kuala Lumpur, worked out the pathology of what is apparently a new glanders-like malady, hitherto called Whitmore's disease or morphia-injectors' disease, but now known to have nothing to do with morphia and renamed *Melioidosis*?

Our work, however, does lack co-ordination. A central clearing-house is needed, and let us hope that the Imperial Institute of Hygiene, the welcome gift of the Rockefeller Foundation to Great Britain, will function to some extent in this direction.

Where, however, we specially fail is in applying the results of our own researches and of those of other nations. Sir Ronald Ross would tell you that for years he has been as a voice crying in the wilderness, and there is no small measure of truth in this statement. Save in certain places, as, for example, the Federated Malay States, we have not tackled malaria as we should have done.

For many years we have known how to combat ankylostomiasis, but, where we have not called the International Health Board to our assistance, we have done little to grapple with the problem.

Tuberculosis is one of the commonest and most deadly diseases of the tropics. Both it and plague are largely dependent on housing conditions, but, as Professor Simpson long ago pointed out, we muddle along without town-planning schemes, and without exercising proper sanitary control as regards human habitations. Happily, however, there is a welcome change in this direction so far as British Malaya is concerned, for there the importance of town-planning is now fully appreciated, as are also its manifold difficulties.

We have long known that filariasis is a mosquito-borne disease and that it might with comparative ease be greatly diminished, if not stamped out, for its chief mosquito vectors are of the domestic type. Yet in many of our colonies elephantiasis, a truly dreadful complaint, is common.

I might easily multiply examples, but it is a depressing business, especially when one compares our efforts with what the Americans have done in the way of ridding the world of yellow fever.

I admit it is largely a question of money, but much more than money is concerned. We do not always, I fear, take these matters with sufficient seriousness; we are apt to lack enthusiasm and high ideals, we are in some ways hide-

bound, we pay too much respect to vested interest and the views of the politician.

Moreover, those who hold administrative posts are not always sufficiently enlightened, and there is a paucity of sanitary engineers.

The outlook is undoubtedly improving, but we are still very far from even a reasonable efficiency, save perhaps in certain favoured places.

Still there is no reason to despair. The West Coast of Africa, though not yet a health resort, is now far from being the white man's grave it used to be. Trinidad has made, and is making, remarkable progress, and a good deal has been done in British Guiana. In Iraq, as Mesopotamia is now called, and in Palestine, much has been accomplished. I noted the other day with special satisfaction that there were no less than fourteen qualified sanitary inspectors on the establishment of Kenya Colony. Mauritius is setting its house in order. Venereal disease is being combated in Uganda. A public health publicity campaign has been established in India, and in Delhi a most successful Maternity and Child Welfare Exhibition was held in 1921. So, as you will see, there is a bright side to the sanitary shield, and though we move slowly, in some ways we move surely.

But we are far too slow. I think I am right in saying that the first qualified British sanitary inspector to be appointed for Government work in the tropics was Mr. Murray, of Leith, who arrived in Khartoum somewhere about 1906. Yet in 1891 I find that Osbert Chadwick in his recommendations on the general sanitation of Mauritius wrote as follows :—

“The sanitary inspectors should be men of good education, not necessarily medical men. They should be acquainted with the general principles of sanitation. In the appendix [that is, to his report] will be found examination papers set by the Sanitary Associations of Great Britain and of Scotland to candidates for the diploma of Sanitary Inspector or Inspector of Nuisances. These, though not perhaps applicable in detail to the requirements of Mauritius, will give an idea as to the essential qualifications of such officers.”

I turned to the appendix, and the first examination paper was headed “The Sanitary Institute, 74A, Margaret Street.” Chadwick, gentlemen, was a far-sighted Sanitarian, and he would have been, I venture to think, pleased and gratified to see in the first place that the Sanitary Institute of his day had become the Royal Sanitary Institute, and in the second that it had established an examination in tropical hygiene for sanitary inspectors. Important step though this is, believe me, it is not enough. There must be in this country a course of instruction in tropical sanitation for sanitary inspectors. Home hygiene and tropical hygiene are two very different things. I grant you that the underlying principles are the same, but in many respects they have little in common, though it is true that they tend more and more to resemble each other. For one thing the advance in tropical hygiene is bringing into force methods hitherto employed mainly in temperate climates; for another, attention has been directed in the latter to the need of measures formerly limited to the tropics, as, for example, anti-mosquito campaigns. This makes it all the easier to train sanitary inspectors to some extent before they leave for the tropics, so that time will not be wasted when they start work, and they will be able not only to take care of themselves, but to carry out their duties in a much more intelligent manner and with due regard to their altered surroundings.

I need not enlarge on this subject, for I have spoken and written about it on many occasions, hitherto, I regret to say, in vain.

It seems to me that the establishment of the new Imperial Institute of Hygiene opens up a vista of hope and that such an institution might well lend a helping hand in the way of training sanitary inspectors destined for our colonies.

As to the utility and value of such appointments there can be no doubt. As long as the right type of men are chosen we need have no fear but that they will prove their worth. Their success is already apparent. Consider the fourteen in Kenya. It is no longer a question of the thin edge of the wedge. There are now quite a large number in the Sudan. As many as sixteen are at work in our West Coast possessions, and I submit that the outlook is infinitely more hopeful on account of their presence, for they form the necessary links between the medical officers of health and their native subordinates, and they aid in that practical application of knowledge which is all-important.

And now let us ask if there is any other way in which the efforts of our executive officers can be supplemented or improved? There is, for one of the great drawbacks to sanitary work in the tropics is the isolation and the severance from centres of light and learning. A man, striving too often to make bricks without straw, feels himself lost and forgotten. "Who cares," he says, "how I do my work so long as it passes muster?" Or, again, he may find himself up against difficulties with which he is unable to cope for lack of knowledge, owing to the fact that he is far from books and journals to which he can refer. This applies not only to men in out-stations, but to the principal sanitary officers at headquarters, though things are very different nowadays from what they used to be, thanks to the admirable *Tropical Diseases Bulletin*, and more especially its Sanitation Supplements. What is wanted, however, is rather sympathy and interest in the work and advice by experts given on the spot and with full knowledge of the existing conditions.

If it can only be arranged, I think it would be an excellent thing to have attached to the Imperial Institute of Hygiene a small band of advisers whose duty it would be to proceed abroad at intervals and to help those responsible for medical and sanitary work in all parts of the British tropics. I am quite sure from what I have seen and heard that such men, if of the right stamp, would receive a hearty welcome. Not only could they render signal aid to many an administrative officer, to many a clinician, to many a laboratory worker, to many a sanitary inspector toiling far from those resources which we have at hand, but they could gather a great deal of valuable information as to the conditions prevailing in, and the needs of, the places they visit.

Moreover, they would bring to bear upon the local problems that freshness of outlook to which I have already alluded and which is so valuable, and they might inspire and encourage those whose lot is cast in the less pleasant places of the earth. I can imagine no more useful type of medical missionary and no mission so far removed from the ordinary kind of inspection, which too often tends to be carping and critical. It is that personal touch which in matters general has recently been extended to the West Indies and which has been so greatly appreciated and cannot fail to be of the greatest service.

As giving you some notion of certain of the riddles to be read and of which

any outlook on tropical hygiene must take cognizance, I would cite the question of epidemics. It is much too large a question for consideration here, but it is very necessary in the future that research work on epidemiology should be encouraged. It has to a large extent been neglected in the past, though there have been some notable investigations, as, for example, that of Christophers on malaria in the Punjab, which showed that the determining causes of epidemics are excessive rainfall and scarcity of food. The subject has also received attention from Buckley, Gill, and Perry in India. Cardamatis in Greece correlated heavy rainfall with malarial epidemicity, but there is still need for inquiry into the determining factors. If this is true of malaria, it is yet more true of plague and cholera. What caused plague to assume epidemic proportions in 1921, and, indeed, to prevail as a pandemic? We simply do not know. It may be that climatic conditions were favourable; there may have been unobserved movements of the rat population; some disturbance in trade routes or in commercial activities may have been to blame. It is useless to speculate, but it is easy to see how advantageous it would be to know the why and the wherefore, and to be able to nip outbreaks in the bud.

Cholera is another case in point. We know all about its methods of transmission, or think we do, but how explain the sudden flare of a cholera epidemic of great intensity and severity, suggesting a heightening in virulence of the virus and the acquisition of unwonted powers of spread?

Again, why do epidemics come to an end? Despite the development of immunity there must always remain ample human pabulum for their causative parasites, and yet they do die out, suddenly or slowly.

Is it possible that d'Herelle has found the key to the mystery? His bacteriophage certainly exists. Does it do all, can it do all that he imagines? Are there infinitesimally small parasites which prey upon the pathogenic bacteria, which develop along with them, attack them and slay them? If so, it is easy to understand how epidemics may be aborted. More research is required into this fascinating problem, into what is possibly an unexplored world of life where wonderful battles are being waged and marvellous victories won.

There is no doubt about the necessity for research, but sometimes one is dubious if we apply properly the knowledge gained.

Are we fighting plague altogether to the best advantage? We spend large sums on poisoning and trapping rats. Are these measures of real utility? I believe they are in certain directions, but I do not think we can ever hope to reduce the rat population materially, much less exterminate it, by such efforts. The rodent breeds too quickly. It obeys too literally the Scriptural injunction: "Be fruitful and multiply." It seems to me we must try and defeat it from what we may call the reproductive side. The Rodier system, as you know, is founded on such a belief, but doubts have been thrown on its efficacy, and it is certainly difficult to apply on a large scale. For one thing it is no easy matter to handle rats, for another it is difficult to distinguish sex in the case of young specimens. This does not apply only to rats. In Mauritius these rodents became such a pest that it was decided some years ago to introduce the mongoose to cope with them. Careful arrangements were made whereby, as a start, a few male mongooses were to be liberated on the island. Alas! someone made a mistake in his determination of sex, and now the mongoose is as great a plague as the rats were, has

almost exterminated the ground game, and has played havoc with the chicken roosts.

At the Institute with which I am connected we have tried to find out some method, some bacterial method, of rendering rats to all intents and purposes unproductive. Our idea has been that by a study of the bacterial flora of the urino-genital tract of male and female rats, there might be found some organism capable of causing abortion—an organism which the male rat might transmit to the female; an organism not dangerous to man but disastrous to the rat's family life. It is true that even were such an organism discovered, the rat would speedily develop an immunity against it in accordance with the mysterious laws of nature which operate against extinction. Still, it is conceivable that such a method of attack might be of great value if applied when plague threatened, when the rat population was found harbouring *Bacillus pestis*. Unfortunately, though at times the outlook seemed promising, and though the research led to some interesting discoveries, we had to admit failure. It is, however, a line of work which might be pursued in the tropics—though I fear it is not very promising. The rat problem is, I confess, one which has so far baffled us, and the only thing to do is to build the animal out—a costly and difficult matter, but one pursued with some success in Java. One might cite other examples, but I will only mention the very big question which the layman is apt to raise.

Is there any use bolstering up feeble lives? Are we right in striving to perpetuate the puny folk of the human race? Is not the old law of the survival of the fittest what was intended, and are we not flying in the face of Providence in trying to upset it? It is not altogether easy to answer such an accusation, and any endeavour to do so would lead one far afield.

Let me only say that the more we work at the problem the more we find that the hereditary transmission of disease plays a comparatively small part in diminishing our vitality. Doubtless something may still be said in favour of feeble constitutions from the time of birth, in support of the theory of diathesis. There seem to be children born with little or no resisting powers; but even here how much depends on the health of the father or the mother? A virile stock produces virile offspring, and we, in our measure of hygiene, aim at virility.

We know beyond all doubt that what saps virility in early life is, as a rule, bad feeding, bad housing, or infection with pathogenic organisms. Study the case of the poor white children in Barbados and Grenada if there is any dubiety on this score.

Hence there can be no question but that we are right in our efforts to save the weakling, if only because we stamp out foci of disease in a humane manner. It is the duty of the physician to save life; it is the duty of the hygienist to preserve it. We may for a space pass through a bad period and perpetuate lives which lack vitality and bodily strength; but eventually we should reach a higher plane of efficiency and compass a better and a saner world. Again, let us remember that amongst these feeble lives there may be one or more possessing that spark of genius which means so much to mankind. A child's death is always unutterably sad, for no one can say what that child might have become. Not once in a million times would the life develop into anything out of the common, but there is just the chance that we lose a Pasteur, a Lister, some great brain, some outstanding personality, some benefactor of humanity.

Therefore we do well to attack disease, dirt, destitution, and drink, by all the *wise* means in our power, and of these means the greatest is education, which, at the present time, is the most crying want in the tropics; education on right lines for the teeming millions of our brown and our black subjects. An officer of the Indian Medical Service was right when he said to me: "We are willing to give up to the Indian medical man everything if we can retain our opportunities for teaching, for research, for carrying out sanitary work." The same is true of Egypt. It would be disastrous to lose our hold on these three essentials, disastrous to the very nations who are struggling for what they regard as freedom.

It would neither be fair to them nor to ourselves to remove our guidance and control in these matters until they have grasped their significance and importance. Do you recall what one of our greatest statesmen said long ago?

Disraeli, when introducing the Public Health Act of 1875, spoke with no uncertain voice.

In a speech, famous for all time, he delivered himself of these words: "A great scholar and a great wit, 300 years ago, said that, in his opinion, there was a great mistake in the Vulgate (the Latin translation of the Holy Scriptures), and that instead of saying: 'Vanity of vanity, all is vanity'—'*Vanitas vanitatum, omnia vanitas*,' the wise and witty king really said: '*Sanitas sanitatum, omnia sanitas*.' Gentlemen, it is impossible to overrate the importance of the subject. After all, the first consideration of a minister should be the health of the people."

I would go even further and say that, so far as the tropics are concerned, it should be the first consideration of the people themselves.

Reviews.

THE CAUSATION OF SEX IN MAN. By E. R. Dawson. London: H. K. Lewis and Co. 1921. Pp. xii and 226. Price 7s. 6d.

In this Third Edition of his little book, which the author had completed before his death, he enunciates his very interesting theory as to the causation of sex in man and backs it up with a considerable amount of clinical material which, in many instances, certainly appears to bear out his theory.

The book suffers from most of the drawbacks of the productions of the hyper-enthusiast, the theory is propounded in a too didactic and dictatorial strain; many clinical instances recorded to bear out the theory appear, to the impartial mind, irrelevant; and other instances are wanting in certain vital particulars; such omissions render them redundant. These shortcomings, however, do not detract from the fact that Doctor Rumley Dawson's theory is the only one, in the reviewer's knowledge, supported by the quotation of definite clinical cases, and not merely the outcome of personal surmise.

It has always appeared to the reviewer inexplicable that the sex question, with its innumerable perplexities in the fathoming of which the laity look to the family doctor for help as guide and philosopher, should have been almost entirely missing in the teaching curriculum of the British medical schools. The newly qualified practitioner is turned out into the world a new-born babe in knowledge of sex and all that that little word of three letters connotes, and it is only after many years of experience and observation in the practice of his profession that he

is competent to furnish the advice to his patients for which so many of them will apply to him.

With all the wealth of clinical materials in the hospitals of the British Isles, and of intellect in the workers in those hospitals, it would appear more than possible that Doctor Rumley Dawson's theory could be either confirmed and raised to the plane of fact, or refuted once and for all. We, however, as a nation, and more particularly as a profession, are so conservative and orthodox that it is too much to expect reaction to this stimulus.

W. C. N.

DE ARTE PHISICALI ET DE CIRURGIA OF MASTER JOHN ARDERNE, SURGEON OF NEWARK, DATED 1412. Translated by Sir D'Arcy Power, K.B.E., M.B.Oxon., F.R.C.S. From a transcript made by Eric Millar, M.A.Oxon., from the Replica of the Stockholm Manuscript in the Wellcome Historical Medical Museum. With coloured frontispiece and 13 plates. London: John Bale, Sons and Danielsson, Ltd., 1922. Pp. xii and 60. Price 10s. 6d.

This is No. 1, "Research Studies in Medical History of the Wellcome Historical Medical Museum," and it affords an admirable example of the printer's art. The original is written in Latin on twelve skins of vellum which form a scroll seventeen feet eight inches long by fifteen inches wide, copiously illustrated with coloured pictures. The reduced photographic facsimile is here reproduced in its entirety. The explanatory notes which the translator has supplied make the text intelligible to the reader unversed in the terms of mediæval pharmacy.

John Arderne was born in 1307. He joined the service of Henry Plantagenet as surgeon, and afterwards that of the Duke of Lancaster. We hear of him at Antwerp, Algeciras, and in Aquitaine. He then practised at Newark from 1349 until 1370 when he came to London. He had established a great reputation as a surgeon. Sir D'Arcy Power remarks that he was a sound practical surgeon who carried out his work by methods which are not very different from those of the modern aseptic surgeon. He taught that wounds should heal without suppuration, and that local applications to them should be little irritating, and that dressings should be infrequent. He invented the operation for fistula which after falling into disuse for nearly 500 years is now employed universally. As a therapist, however, he reflected the credulity and empiricism of his times. Absurd and revolting mixtures of many herbs, animal matter and excretions were among his specifics, aided by spells and incantations. Thus his cure for epilepsy is: "write these three names with blood taken from the little finger of the patient, 'Jasper,' 'Melchior,' 'Balthazar,' and put with gold, frankincense and myrrh in a box. Let the patient say three paternosters and three Ave. marias daily for the souls of the fathers and mothers of these three kings for a month . . . and without doubt this remedy never fails." For the relief of cramp the inscription is even more elaborate. He adds that he who carries this charm upon him in good faith and firmly believes in it will without doubt never be troubled with the cramp. Nevertheless we must not be unduly critical, as we ourselves live in an age in which belief in spiritualism, telepathy, Christian science, water diviners and mascots thrive so amazingly that the editors of magazines and newspapers find these themes so congenial to their readers that they are thrust before our notice by prominent headlines, and much space is devoted to their serious discussion in which scoffers are rebuked severely.

Correspondence.

THE FILTER PASSER OF INFLUENZA.

REPLY TO DR. WOODCOCK'S CRITICISM.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—The evidence associating influenza with a filtrable virus was condensed in my paper under two chief headings: (1) The result of experimental attempts to reproduce influenza; and (2) the evidence obtained by cultural and microscopical investigation of material from cases in the acute stage of this disease. As Dr. Woodcock offers no fresh evidence under the former heading, I must confess that his views on the ætiology of influenza fail to impress me. The chief burden of his paper, however, is with reference to Giemsa's stain, and I gather that he is strongly of the opinion that the minute bodies shown in the figures illustrating my article are not organisms at all, but merely granules derived from broken-down cells; and further, that he bases this view largely on the circumstance that they stain red with Giemsa.

Now first as regards the figures illustrating my paper, it is hardly necessary to point out that no photomicrograph can ever completely represent the preparation from which it is taken. The best representation, however, that I have yet seen of the influenza filter-passer is the photograph taken by Mr. Welch, Mr. Barnard's assistant, and shown in fig. 1 attached to my paper. This figure Dr. Woodcock passes over in silence. The preparation from which it was made was examined very carefully by one of the leading microscopical experts in the country, who measured the minute bodies with monochromatic light and commented on the uniformity of their size. Fig. 2, representing nasal secretion at the very onset of influenza, meets with Dr. Woodcock's criticism on the ground that there is much variation in the size of the bodies there shown. That is only natural, because the two bodies in the middle are bacteria—forms of *Bacillus septus*—whereas the smaller bodies swarming in most parts of the field are morphologically identical, in my opinion, with the bodies shown in fig. 1, and obtained by cultivating the Berkefeld filtrate of similar material in the medium of Noguchi. The film from vaccine lymph, fig. 4, is not so successfully photographed or reproduced as figs. 1 and 2; it was exhibited in order to show that in vaccine lymph bodies can be demonstrated of similar size and shape to those present in the nasal secretion at the onset of influenza.

The gravamen, however, of Dr. Woodcock's attack is that the minute bodies here in question stain red with Giemsa's stain. Now in the first place I do not admit that red colouration with Giemsa necessarily disqualifies such bodies from being those of an organism. Before now I have seen excellent preparations of spirochaetes stained red with Giemsa. *Pace*, the dictum of the late Professor Minchin, I refuse to be hypnotized by the label "chromatin," of which, by the way, there must be a large number of different kinds. It is true that sometimes the influenza filter-passer does stain red with Giemsa. When experimenting with fixatives I once obtained a particularly convincing film of it in which the

minute bodies of this filter-passer were stained a deep ruby-red, and were in striking contrast both to the purple staphylococcus which I had purposely added to the film, and also to the accompanying lighter brick-red amorphous granules of protein deposit. A control experiment with eosin alone stained the protein particles, but not the filter-passer. The chief difficulty, however, that I have in accepting Dr. Woodcock's ban is that, as a rule, and including the particular preparations shown in figs. 1 and 2 of my paper, the filter-passer does not stain red with Giemsa at all, but a violet or lavender colour! Moreover, Giemsa is only one of the staining methods employed by previous investigators and by myself for identifying the presence of these minute stain-resisting micro-organisms. Repeatedly my results with Giemsa have been controlled and confirmed by using Löffler's flagella stain, methyl blue, and occasionally azur I. as well. For several weeks at a time I have not employed Giemsa at all, but have worked entirely with other stains. It may interest Dr. Woodcock to know that I have tried a large number of fixatives and almost all the stains I could get hold of, some sixty in number, but beyond mentioning the facts of positive value that emerged, I did not go into further details in my paper because I did not wish to bore my audience at this stage of the work. I obtained good results with freshly made Mayer's hæmalum, but after it had been kept for a short time, although the hæmalum stained ordinary histological sections as well as ever, it no longer stained the filter-passer. I have since found evidence that previous observers have noticed the same thing. I understand that iron hæmatoxylin has been found to stain filter-passers, but when I tried it I could not satisfy myself on this matter and do not recommend the stain; but perhaps Dr. Woodcock, who is doubtless more expert with this stain, might obtain better results. For further particulars as to the staining and other properties of filter-passers I must refer Dr. Woodcock to the well-informed and comprehensive article of Lipschutz in vol. 8 of Kolle and Wassermann's book (1913), and to a recent article by Rocha-Lima in vol. 2 of v. Prowasek's *Pathogenen Protozoen* (1920).

It may be mentioned in passing that the presence of these exceedingly minute and elusive micro-organisms has been demonstrated by other than staining methods. MacCullum's recent paper (*Journ. Amer. Med. Assn.*, February, 1922), in which he described the result of his careful and ingenious studies of the virus of vaccinia, proved beyond doubt that the virus in question is particulate and subject to gravity; and he even succeeded in determining the specific gravity of this filter-passing organism, which he also saw with the dark-ground illumination, and found to be similar in form to the bodies described and cultivated by Paschen and shown in my fig. 4. Proescher, it may be added, claims to have succeeded in cultivating the vaccinia organism through over twenty successive generations, and to have produced typical vaccinia experimentally with the twentieth subculture. He finds that enrichment of the tissue medium with maltose materially improves the growth of this minute organism of vaccinia (cf. Rocha-Lima, *loc. cit.*).

The filter-passing organisms are distinguished from albumin precipitates, etc., by amongst other things, the uniformity of their size, the sharpness of their contour, and by their resistance to caustic potash, acetic acid, ether, chloroform, and trypsin. Further points that have been emphasized by previous investigators are the constancy of these organisms in the particular pathological secretions in which they occur, their vast abundance in such materials (corresponding with the

high infectivity), and their absence in control materials. As stated in my paper, up to the present, so far as my own observations have overlapped with those of previous investigators, I have obtained complete confirmation of their work. The study and cultivation of these minute anaerobic and stain-resisting organisms that have held up the progress of medicine for so long is a matter that one expects to be difficult. That very circumstance, however, and their extreme pathogenic importance, are features that render them especially attractive as a subject for research. I am very glad that Dr. Woodcock has formulated his doubts, and I wish to thank him for the courteous tone of his scientific attack. Criticism of this kind is both instructive and stimulating. His enzyme hypothesis is ingenious, but I think highly improbable. I have little doubt that we shall ultimately find that filter-passers manufacture enzymes; at the same time study of the filter-passer group makes one feel somewhat contemptuous of enzymes; for these minute micro-organisms appear under favourable circumstances to be present in such enormous numbers, that in spite of over twenty years' experience of bacteriology I am amazed at such prodigious multiplication. It is to be hoped that those who have the opportunity of investigating outbreaks of influenza, or other diseases in which a filtrable virus is a possible factor, will not hesitate to search patiently for these organisms. Strange as it may seem, there is no law of nature that all pathogenic micro-organisms must be at least 0.5 of a micron in size; and everything below that is not necessarily protein deposit! It is difficult to avoid the suspicion that in spite of learned talk about protoplasm, chromatin, enzymes, and so on, the morphologists are as much in the dark about these minute filter-passing organisms as the rest of us. However, "There are more things in heaven and earth," etc.

St. Bartholmew's Hospital,
September 20, 1922.

I am, etc.,
M. H. GORDON

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Journal
of the
Royal Army Medical Corps.

Original Communications.

RABIES IN IRAK, AND ITS TREATMENT BY CARBOLIZED
VACCINE.

BY LIEUTENANT-COLONEL A. E. HAMERTON, C.M.G., D.S.O.

*Royal Army Medical Corps; late Assistant Director of Pathology, Irak (from the
Central Laboratory and Pasteur Institute, Bagdad).*

DURING the Great War and the subsequent rebellion in Irak considerable loss of service and expense to Government were caused by the lack of local facilities for the treatment of rabies. Between two and three hundred men had to be sent every year to the Pasteur Institute at Kasauli for antirabic vaccination. Moreover, the unavoidable delays in the long journey from up-country stations in Irak resulted in the death from hydrophobia of a number of soldiers who—arriving in India too late for effective treatment—succumbed to this disease en route to Kasauli, or soon after arrival there. Now in 1910, Colonel Sir David Semple, R.A.M.C., [1] anticipating the needs of a large field force operating in the East, initiated and perfected a simple method of preparing a safe and efficient antirabic vaccine that any competent bacteriologist could carry out for the treatment of rabies locally, at a base or central laboratory.

The vaccine is prepared by emulsifying the brains of rabbits, that have died from inoculation with “fixed” rabies virus, in a dilution of carbolic acid of sufficient strength to kill the virus, but insufficient to destroy the antibodies present in the affected nerve tissue or to destroy its immunizing properties. This carbolized vaccine has stood the test of statistical examination and animal experiment by many investigators working independently, and has been used for many years as the standard antirabic treatment in all Pasteur Institutes throughout the Empire [2]. It is

THE DIAGNOSIS OF CANINE RABIES.

(1) Clinical.

(2) In the Laboratory.

(1) Human rabies, or hydrophobia, is amply described in leading medical text books, and I will refer the reader to a classical description of a typical case by the late Colonel Sir P. J. Freyer, K.C.B., I.M.S. [3].

The Army doctor in the East is not infrequently required to give an opinion on cases of suspected rabies in dogs: a disease which is best described in veterinary text books not always accessible abroad. I therefore cull from a leading authority [4] the following account of the clinical signs and symptoms of canine rabies:—

“At the initial stage of the disease the animals show a peculiar change in behaviour, they become capricious, irritable and gloomy, hiding in dark places under the furniture, or in dark corners of the room, and are sluggish in obeying the call of their masters; or they may show a restless uneasiness, constantly moving here and there, stopping suddenly and without cause, barking and biting at the air as though catching imaginary flies. The reflex excitability is decidedly increased and is shown by the fact that the animals when approached in a friendly way will become excited and snap at the caressing hand, or they will be startled and jump up at the slightest external cause, such as strong light or a sudden noise. At the same time the animals will disregard their ordinary food, which they will let drop out of their mouths. They show a perverted appetite for all sorts of rubbish and will chew up paper, sticks, and eat their own excrement. It will be noticed that they have difficulty in swallowing and the onset of pharyngeal spasm is further shown by dribbling of saliva.

“After one to three days the stage of unrest and excitement will increase and may pass into violent rage in which they leave their homes and wander aimlessly about, furiously snapping at and biting every creature within reach. If tied up at this stage, they will savagely bite their chain or the bars of their cage and tear up and swallow earth and stones. In this stage the symptoms of pharyngeal paralysis soon appear, as shown by a peculiar change in the tone of the bark which becomes hoarse and accompanied by long drawn-out howls. Water or food cannot be taken, and attempts to swallow cause paroxysms of respiratory spasm.

“After three or four days the rage subsides and is followed by symptoms of insensibility and dullness. The existing paralysis becomes more conspicuous, especially in the muscles of the jaw, tongue and eyes. The jaw droops, the tongue hangs out of the mouth, and long threads of viscid saliva flow from the lips. Paralysis of the hind limbs follows and the animal is seen to stagger and fall on attempting to run; and later the paralysed hind limbs are dragged along the ground. This condition is rapidly followed by extension of the paralysis, and death which, be it noted, invariably occurs within ten days.

“It sometimes happens that the stage of irritation and excitement is so

brief or transient as to pass unnoticed ; the paralysis of the jaw and throat being the first symptom to attract attention. The owner, thinking that the dog has a bone in its throat may attempt to extract it, and in so doing infect himself with hydrophobia. Paralysis of the dog's hind limbs rapidly follows and it always dies within three or four days. This form of the disease, during the course of which the animals are, from the beginning, too weak to bark or bite is known as 'dumb rabies' ; in contrast to the typical violent rabies."

(2) The Laboratory diagnosis of Rabies depends upon the finding of Negri bodies within the pyramidal cells of the brain. These cells are most readily found in considerable numbers in smears and sections taken from the hippocampus major. Negri bodies are found in ninety-seven per cent of cases of "street" rabies. Whether the bodies mark deposits of the causal organism, or represent merely cellular changes or activities brought about by the stimulus of the virus (*Hæmatophagy*, *Hæmatoboly*) is a matter of opinion—which the recent work of Woodcock has enlightened [5]. It is generally accepted, however, that the presence of Negri bodies within the pyramidal cells or in the cells of Purkinje is conclusive proof of rabies ; but unfortunately if they are absent one cannot infer the contrary. In removing the brain of a dog suspected of rabies great care should be taken, for it must be remembered that the brain tissue and the saliva may be infective and must not come in contact with the hands ; it is therefore best to wear an old pair of riding gloves when performing this operation.

The head of the dog should first be washed in some antiseptic solution. If post-mortem instruments are available, it is quicker and neater to saw off the calvarium in the ordinary way ; or a hammer may be taken and with a few sharp blows through the intact skin, the top and sides of the brain cavity can be broken into several pieces. Lateral flaps of the skin are then turned back, the fractured pieces of the skull removed and the brain exposed. Incise the membranes, remove the brain intact and put into a Petri dish. Divide the brain through the corpus callosum into two longitudinal halves. Put one half into a wide-mouthed jar previously padded inside with a layer of cotton wool at the bottom, and fill up to the top with methylated spirit or ninety per cent. alcohol. Seal up the jar and, if necessary, it can then be sent to a distant laboratory for section cutting.

To expose the hippocampus major : Take the other half of the brain and with a sharp razor shave successive layers off the top, until the lateral ventricle is exposed. The choroid plexus will be seen lying on the optic thalamus. The choroid plexus, being taken as a guide, should be traced backwards and downwards to where it descends into the depths of the middle or descending cornu of the ventricle which can be cut away along its outer side, exposing the hippocampus major as a prominent convex fold, chiefly of grey matter, occupying the inner side of the cavity.

With a fine pair of scissors snip through the hippocampus and remove a segment about the size of a split pea and put into ten per cent formalin

solution, for fixing and subsequent section cutting if Negri bodies cannot be found in smear preparations. These should be made as follows:—

Snip another very small and thin portion off the hippocampus and press it out into a thin film between two perfectly clean microscope slides and, without separating the opposing surfaces of the two slides, draw them apart quickly so that a thin even smear of brain substance is drawn out along the two slides, which should be dropped, whilst the smears are still wet, into a jar of methyl alcohol used for fixing. Whilst the films are fixing, make up fresh the following stain [6] which I have found to be the most convenient and satisfactory of all the numerous staining methods recommended for Negri bodies. It is just as good for sections as for films.

Put fifty cubic centimetres of distilled water in a measure glass—add three drops of saturated aqueous solution of methylene blue, shake up and then add four drops of saturated alcoholic solution of basic fuchsin (if permanent section preparations are required make the stain up in fifty cubic centimetres of a five per cent solution of carbolic acid instead of water).

The slides should now be taken out of the methyl alcohol, which should be allowed to dry off—then flood the smear with the stain for five minutes, heating gently until steam arises. Examine under a low power objective and look for pyramidal cells which will often be found clumped together in one part of the film. They should be stained light blue; if densely stained soak the slide in water and control the decolorizing under $\frac{1}{4}$ -inch objective.

Preparations thus obtained have the advantage of presenting various depths of staining, some parts being too heavily stained, others too lightly, whilst in the intervening parts Negri bodies appear under the $\frac{1}{2}$ -inch objective as brilliant pink dots, globules or oval bodies in a light blue mounting formed by the pyramidal cells. Careful focusing will reveal in the depths of the Negri body a few dull bluish points or granules. If the stain is made up with five per cent carbolic solution instead of water, the Negri bodies take a bright ruby red colour in contrast to the cell nuclei which stain deep purple or chestnut. Sections after staining as above described should be dehydrated rapidly as follows:—

(1) Wash in water; (2) place in distilled water for five minutes; (3) place in rectified spirit for one second and dry with blotting paper; (4) clear with xylol and mount.

Negri bodies may be so numerous as to be present in nearly every pyramidal cell, or they may be so scarce as to require prolonged search through many slides before a typical and indisputable specimen can be found. In canine and jackal rabies, however, they are generally found at once in smear preparations, and an immediate diagnosis can be made without the necessity of cutting sections. If the finding in smears is difficult or uncertain, stained sections should always be examined before pronouncing an opinion.

In cases in which the finding of Negri bodies was controlled by biological test, the rabbits died of rabies between the sixteenth and nineteenth day after subdural inoculation with 0.2 cubic centimetre of emulsion of the cerebellum of the suspected animal. In one case in which prolonged search failed to reveal Negri bodies, but in which the clinical evidence was convincing, the biological test proved positive.

I consider it important that the first case or two that occurs in a district should be biologically proved; for if the diagnosis is unquestionably rabies, then more cases may be expected and due precautions should be enforced without delay. In cases clinically suspicious of rabies, but negative on investigation for Negri bodies, the biological test should be done.

The necessary subdural inoculation of a couple of rabbits or guinea-pigs can easily be done without any special instruments. A cork-borer of about $\frac{3}{8}$ -inch calibre does very well instead of a trephine; forceps, a scalpel and a little surgical handicraft are presumably always available.

THE MANUFACTURE OF ANTIRABIC VACCINE.

The vaccine is made, as will be described presently, from the fresh brains of rabbits that have died as a result of subdural inoculation with "fixed rabies" virus. A local strain of fixed virus may be acquired from the original "wild" virus as found in the fresh brain of a naturally infected rabid dog, wolf or jackal and commonly termed "street" virus. This "street" virus, when inoculated subdurally upon a rabbit's brain, has a variable incubation period of fourteen to thirty days preceding the onset of symptoms.

If a strain of this virus is carried on from rabbit to rabbit by subdural inoculations of brain substance, the virulence of the poison becomes curiously altered in that the incubation period diminishes—possibly because of more rapid proliferation of the virus by successive "passages" through rabbits—until after some thirty or more of such inoculations we find the period of incubation of the disease has become reduced to a fixed limit of about seven days, followed by death not later than the tenth day. In contrast to the original "street" virus, however, the fixed virus—when injected subcutaneously—appears to be incapable of penetrating to the higher nerve centres and causing symptoms. It would be interesting, however, to have more experimental data on this matter, the explanation of which seems obscure.

Since the preparation of fixed virus is tedious and expensive in animals, it is convenient to obtain the strain of fixed virus from one of the Pasteur Institutes already established. It must be remembered that the virus is extremely delicate, and in hot weather would probably be killed during transmission through the post. Aeroplane transport would solve this difficulty—but in Bagdad it was necessary to get the virus sent over from Kasauli in live rabbits, relays of which were subinoculated as required during the journey.

Having obtained the fixed virus killing on the tenth day—in a portion of brain preserved in glycerine—a piece of the infected brain about the size of a pea is snipped off with sterile scissors and dropped into a sterile conical glass. Now wash off the glycerine in a little distilled water, pour off the excess of water and pound the bit of brain thoroughly with a sterile glass rod until it is a smooth homogeneous pulp; then add, drop by drop, one cubic centimetre of sterile distilled water from a sterile one cubic centimetre syringe, mixing thoroughly with the rod to form an even emulsion. Draw this up into the one cubic centimetre syringe, turn down the screw top of the syringe so that it will eject 0.2 cubic centimetre. Place the syringe and its contents in a sterile Petri dish and lay aside in the ice chest until wanted. Now take a full grown healthy rabbit. Snip the hair off the top of its head between eyes and ears, and swab the clipped area with iodine. Place the rabbit on a table and slip four loops of tape over the legs and tie each extended leg to nails conveniently fixed in the table. Anæsthetize the rabbit by pouring ether on a pad of wool held over the rabbit's nose, and then wash its head in one in twenty carbolic. The assistant giving the ether should now place one thumb over each of the rabbit's eyes and retract the skin when the incision is made. Make a longitudinal incision down to the bone, one inch long, and with its mid-point opposite the posterior margin of the orbit. The assistant retracts the edges and slides the wound slightly to the left of the middle line. Apply a trephine (0.5 centimetre in diameter) mounted on a hand drill, and drill a hole through the skull, exposing the dura just to the left of sagittal suture and longitudinal sinus. Now take up the syringe containing the fixed virus in brain emulsion already prepared, and push the needle point under the dura, passing it forwards towards the rabbit's nose as far as it will go, keeping it as near as possible parallel to the under surface of the dura; then withdraw the syringe very slowly, injecting meanwhile 0.2 cubic centimetre of the brain emulsion along the needle track. Having withdrawn the needle, close the skin wound with a stitch or a Michael's clip. No dressing is required. If the anæsthetic has been skilfully given and the operation dexterously performed, the rabbit should have recovered normal liveliness by the time it is untied and replaced in its cage, when within a few minutes after the operation it should be sitting up drinking the water and eating the grain provided. Finally, the details of the inoculation, number of the rabbit, etc., are entered up in a book, and the cage labelled with the number and date.

On the sixth or seventh day after the operation it will be observed, on disturbing the rabbit, that it has lost the power of judging the distance and the muscular effort required in jumping from one side to the other of its cage. The animal takes too forcible a spring and bangs its nose up against the wall of the cage towards which it jumps. This very early and, I believe, characteristic symptom of fixed virus infection should be noted. Within twenty-four hours of this first symptom appearing, a very fine tremor of

the ears and head will be observed, and the next day, if taken out of its cage and allowed to run about, the creature will be seen to have a reeling gait, as though intoxicated. On the ninth or tenth day it will be dead or dying. If it dies on the ninth day, its brain can be used for the preparation of vaccine only. If it survives until the tenth day, and is then obviously moribund, it can be used for subinoculation or "passage" and for the preparation of vaccine also. If the rabbit has died before the ninth day, its death has been caused by some intercurrent malady, and the animal should be discarded. During a period of intense heat in Bagdad, the virus seemed to lose its strength and did not kill until the twelfth or thirteenth day after inoculation. One passage of the virus through a guinea-pig, however, was followed by the restoration of its original lethal effect on rabbits, in which it remained stable, killing on the tenth day, until last summer, when, I am informed, it had to be "restored" again—this time by passage through a monkey. The stock virus should be maintained by passage from rabbits dying only on the tenth day. Occasionally a rabbit escapes and does not die. Such an event is probably due to a defect in technique, and will be of very rare occurrence after a little practice and careful attention to the details above given. Assuming that the inoculated rabbit is dead or dying on the tenth day (if moribund it can readily be dispatched by injecting a syringe full of air into its auricular vein), it should be disinfected by immersion in a pail of cresol for a couple of minutes. The floor of the room and the operating table should be swabbed with cresol; the dead rabbit laid out with its head resting on the edge of the table and its legs tied out behind. Whilst an assistant grasps the rabbit's muzzle with lion bone forceps, take a sterile knife and make a medium incision extending from the nape of the neck to half way down the nose. Reflect the skin on either side of the roots of the ears and the edge of the orbit without opening either. Swab the whole flesh surface with 1 in 20 carbolic and sear with a hot iron the site of the trephine hole in the skull. A culture from the rabbit's brain can now be taken by pushing a platinum wire through the seared trephine hole and, on withdrawal, inoculating an agar slope to make sure that there is no secondary infection of the brain with pyogenic organisms. Now sever the head from the vertebral column by inserting the point of a sterile knife between the occiput and atlas. Take the bone forceps, put one blade in the occipital foramen and nibble away the top of the skull as far forward as the frontal lobe. The whole upper surface of the rabbit's brain will now be exposed. It should be normal in appearance, and there should be no indication of inflammatory reaction in the surrounding tissues.

Before proceeding further, snip off a portion of the cerebellum about the size of a pea and put it into a sterile test tube half filled with equal parts of glycerine and distilled water—not saline solution, for it would weaken the virus. This is the reserve supply of the virus, which should be sealed up in the tube and kept on the ice in the ice-chest to be used in the event of any mishap to the rabbit about to be inoculated.

412 *Rabies in Irak, and its Treatment by Carbolyzed Vaccine*

Snip off another portion of the cerebellum and drop it into a sterile conical glass, cover up and put aside in the ice chest for a while.

Now proceed to remove, with sterile forceps and scissors, the brain intact from before backwards. Place it on a sterile watch glass which has been previously weighed; weigh again on a chemical balance. It is sufficient to weigh to the nearest centigramme.

Suppose the weight of the glass plus the brain equals	15.22	grammes
weight of the glass only	8.12	"
net weight of brain	7.1	"

Now in making the vaccine the first step is to prepare an emulsion of this brain with one per cent solution of carbolic acid in the proportion of one of brain to fifty of the solution. Hence the carbolic solution required will be:—

$$7.1 \times 50 = 355 \text{ c.c.}$$

Having made up 355 cubic centimetres of one per cent carbolic solution and put it into a sterile graduated glass cylinder with delivery nozzle such as is used for delivering intravenous medication; take the brain and put it into a sterile earthenware mortar about three to four inches in diameter. Pound it up thoroughly until of paste-like consistency, and whilst braying up the brain in the mortar, see the carbolic solution tested by an assistant, who will put a little of it into a test tube and add a few drops of perchloride of iron: a dirty blue colour appears if the solution is correct. When the brain has been comminuted and ground into a stiff paste, add the carbolic solution very slowly—grinding in the meantime, to make a good emulsion.

In the dusty atmosphere of Bagdad, it was necessary to carry out this operation under a sterile bell-jar in a perfectly still room previously swabbed with cresol to lay the dust.

As the mortar is filled, decant the contents through a layer of fine muslin stretched over an ordinary tea-strainer supported on the rim of a conical glass (urine specimen glasses do very well)—everything of course having been previously sterilized.

After all the liquid has been strained, decanted into conical glasses and covered with the lids of Petri dishes, the muslin strainers, with shreds of brain tissue entangled therein, are placed in the mortar and brayed with carbolic solution, which takes up in suspension the remaining brain substance. The washings of the strainers are then added to the bulk of the emulsion. We have now got in emulsion all the brain matter, without the vascular and connective tissue, which remains behind entangled in the muslin.

Pour the contents of the conical glasses into a sterile litre flask, and add carbolic solution until the whole amount of 355 cubic centimetres has been added. Replace the plug of wool in the flask and write on it the number and amount in cubic centimetres of the "brew," put it in the 37° C. incubator and leave for twenty-four hours. Next day the

emulsion is further diluted by the addition of 355 cubic centimetres of normal saline solution. The whole, being well mixed, is now poured into a sterile glass cylinder or funnel on a stand, from which the vaccine is run off into 30 cubic centimetres sterile bottles that can be capped with sterile rubber caps, which should be tied on and hermetically sealed by dipping into hot melted wax.

Sterility tests should be made by running out the last few cubic centimetres of vaccine from the delivery tube into broth, on an agar slope, and into anaerobic broth culture media, which after incubation for seven days at 37° C. should shew no growth. When the vaccine has been stored for some weeks the sterility tests should be repeated on every bottle a few days before use. This additional precaution may be unnecessary in cool hill stations.

If the first test showed the vaccine was contaminated in bulk the whole "brew" must be thrown away and any bottle found contaminated at the second test should be discarded.

During the hot weather in Bagdad, when sandstorms were prevalent, contaminations with spore-bearing organisms were not infrequent. With improvement in the technique, however, these accidents became uncommon. It must be remembered that only by the most careful supervision and fastidious attention to details of sterilization throughout the whole process of manufacture can sterility be ensured, and unpleasant and possibly discreditable effects of treatment be prevented.

Now to go back to the removal of the brain from the rabbit's skull. The portion of the cerebellum placed in the glycerine can be kept in the ice chest for several weeks to inoculate more rabbits in case of accident to those inoculated forthwith. With the second portion of cerebellum that was laid aside in the ice chest we should now proceed to inoculate a couple of rabbits for the maintenance of the fixed virus. In Bagdad it was customary to inoculate two fresh rabbits every tenth day.

Rabbits dying on the ninth day may be used for vaccine but not for "passage." No portion of brain from a ninth day rabbit need be preserved in glycerine.

Rabbits dying of rabies after the tenth day should not be used.

Inoculated rabbits must be kept in separate cages.

Provided that the vaccine is stored in an ice chest, or refrigerator kept below 5°C., it is said to retain full immunizing properties for three months—after which it should be discarded.

INDICATIONS FOR ANTIRABIC TREATMENT.

The decision as to whether a person has or has not been subjected to the risk of hydrophobia when bitten by an apparently healthy dog in a rabies-infected country depends upon the following points:—

(1) A dog cannot have been infective for more than ten days prior to the onset of its symptoms.

414 *Rabies in Irak, and its Treatment by Carbolized Vaccine*

(2) The virus cannot penetrate unbroken surfaces, whether of skin or of mucous membrane.

(3) From a practical point of view it is wise to assume rabies to be present if an undiagnosed disease in a dog is of short duration and ends in death : and in cases of unprovoked attack, especially if the owner of the dog or a number of persons have been bitten.

(4) If a jackal attacks a human being without provocation it is almost certainly rabid.

The procedure that should be adopted in practice is as follows :—

If possible keep the suspected animal under observation for ten days and keep the patient waiting until the period of observation has passed—unless the bite is on the face or otherwise near the brain, in which case it is not safe to risk any delay in immunizing the patient. If ten days after inflicting the bite the animal is alive and well, then it cannot have conveyed infection and the bitten person is free from risk. If, however, the animal shows symptoms of sickness or dies or escapes during the ten-day period, treatment by vaccine should be commenced without delay, and on no account should it be postponed until a microscopical examination of the dead dog's brain is made, for though a positive result would be decisive, it must be remembered that a negative examination does not exclude the presence of rabies.

LIMITATIONS OF ANTIRABIC TREATMENT.

The object aimed at in antirabic treatment is to confer an active immunity against rabies before the virus in the saliva of the animal which inflicted the bite reaches the nerve centres ; when this has been accomplished the failures rarely exceed 0·8 per cent. On the other hand, should the virus have already reached the nerve centres by the time the patient has arrived for treatment, there will be no symptoms to show that this has taken place, but hydrophobia will set in fourteen days or so afterwards, irrespective of whether he receives treatment or not. Suppose for instance the virus reaches the brain of a bitten person one day before the course of treatment is completed, the patient will develop hydrophobia fourteen days afterwards and during this interval he will not have a single symptom to show that the object of treatment was defeated one day before completion. The explanation of such a case is clear ; since we know that street virus planted direct on the brain of a rabbit has an incubation period of at least fourteen days, and that no treatment subsequent to direct inoculation of the virus on the nerve centres will prevent the onset of rabies. Now antirabic treatment extends over a period of fourteen days, and the time occupied by the virus in growing up the nerves to the nerve centres is variable and mainly dependent on the proximity of the bite to the brain. The importance of early treatment is evident, for we have to set going a race between the growth of a disease and the progress of immunity in which immunity is handicapped by disease having a considerable start. If the

disease wins and reaches the vital nerve centres before their defence is organized, the patient will be in the same hopeless condition as a rabbit would be, had it been inoculated directly upon the brain with street virus.

METHODS OF TREATMENT.

(1) *Local*.—Cauterisation of the wound when thoroughly carried out within half an hour of infliction of the bite will prevent hydrophobia in some cases, but not in all. It is probably not much good after three or four hours, and certainly quite useless after twenty four. Local treatment at best can only reduce the chance of infection by diminishing the virus in the wound and prolonging the incubation period of the disease, so that the vaccine treatment is made easier and more certain of success. Undiluted carbolic acid is the best caustic to use and it should be well swabbed into the depths of every tooth mark.

(2) *Administration of vaccine*.—Not a day or even an hour should be unnecessarily wasted in sending persons exposed to the risk of hydrophobia to the Pasteur Institute for treatment. If this is impossible, the vaccine, packed in ice in a thermos flask, can be sent to the patient and injected by a local doctor. It is more satisfactory however that the patient should attend the Pasteur Institute daily as an out-patient during the fourteen days of treatment.

The following details of each case should be recorded.

- (1) Particulars of patient.
- (2) Station where bitten.
- (3) (a) Whether bitten or licked by animal proved to be rabid (i.e., Negri bodies found).
- (b) Whether bitten or licked by animal certified to be rabid (by Vet. or M.O.).
- (c) Whether bitten or licked by animal suspected to be rabid.
- (4) Number and position of wounds.
- (5) Description of wounds; whether punctures, abrasions or through clothing, and if cauterized?
- (6) Position of wounds and interval between date of bite and the commencement of treatment.

Whilst these details are being booked, sterilize a large size Roux syringe by filling and expelling from it eight or nine times, hot oil maintained at a temperature of 140°C . Then push the needle of the syringe through the waxed rubber cap of a bottle of vaccine and withdraw two cubic centimetres of the vaccine for each patient to be treated. The amount of vaccine withdrawn should be expelled into a sterile gallipot; an equal amount of sterile 0.85 per cent salt solution is now taken up in the syringe and thoroughly mixed with the vaccine in the gallipot.

We have then a suspension of 0.5 per cent brain substance, 0.25 per cent phenol, and 0.85 per cent salt.

416 *Rabies in Irak, and its Treatment by Carbolized Vaccine*

Each patient, however severely bitten, receives daily doses of five cubic centimetres of this suspension for a period of fourteen days. Two and a half cubic centimetres are inoculated on either side of the middle line of the abdomen by inserting the point of the needle at an acute angle between the superficial and deep layers of the skin and pressing out the vaccine between the epidermis and dermis, i.e., intracutaneously rather than subcutaneously. It is usual to dab a little tincture of iodine on the skin before inserting the needle. The total amount of brain substance injected is about 0.25 gramme for each patient. Roux syringes holding five cubic centimetres are most suitable for injecting the vaccine. The needle should be sterilized by dipping it in hot oil between inoculation of each patient. The inoculation causes no pain, no general reaction and no local reaction beyond a little redness and itching of the skin. Patients should be advised against taking alcohol or indulging in any unnecessary physical exertion during, and for ten days after completion of, treatment. At the conclusion of the course of inoculations each patient is given a stamped addressed post card and requested to inform the Director of the Institute of the state of his health three months after treatment.

Hydrophobia usually develops before the eighth week after infection in those who arrive too late for treatment. Patients reported to be alive three months after completion of treatment are recorded as having been successfully vaccinated.

RESULTS OF ANTIRABIC TREATMENT IN BAGDAD.

During the last six months of 1921, 137 patients attended the Central Laboratory for antirabic treatment by carbolized vaccine.

Up to the time I left Irak in May, 1922, no case of hydrophobia nor any unpleasant after-effects of the treatment had occurred.

Analysis of the records shows that sixteen per cent of the patients were bitten by animals proved by the laboratory investigation (i.e., by biological test or by the finding of Negri bodies) to have been rabid at the time of biting, and 10.9 per cent were bitten by dogs not examined in the laboratory, but certified by veterinary medical officers to have been rabid. In 26.9 per cent of the cases treated there was evidence of rabies in the biting animals, though evidence on clinical grounds only cannot always be regarded as conclusive.

COST OF ANTIRABIC TREATMENT.

Provided that there is a well-equipped laboratory already established for general bacteriological work, the additional outlay required is trivial, and any extra allowances that may be granted to the personnel would probably be more than covered by fees obtainable in payment for treatment of Civil Servants, etc.; money that, presumably, would be claimed by the Military Financial Authorities, as was the case in Irak.

The cost is roughly estimated as follows :—

Initial Expenditure.

Outlay for instruments and apparatus	..	..	..	Rs.
Cost of rabbits imported from Kasauli	..	..	..	620
Cost of rabbit hutches, etc.	..	..	..	208
				360

Rs. 1,188

Recurring Expenditure.

Salary of 1 Assistant Surgeon I.M.D., at say	..	..	Rs.
„ „ 1 R.A.M.C. Laboratory Attendant	..	..	450 per month
„ „ 1 extra Sweeper	..	..	200 „
Charge allowance for the responsible Medical Officer	..	..	14 „
			250 „

Rs. 914 „

The cost of rabbit food is difficult to estimate and is not included. Cut grass was supplied daily from the military grass farm and crushed oats and gram was supplied in bulk by the R.A.S.C. in Bagdad.

The successful breeding of rabbits is an essential item in the maintenance of a Pasteur institute. A note on the care of these animals is appended.

In conclusion, I desire to acknowledge my indebtedness to the Committee of the Pasteur Institute of India for their assistance in enabling me to establish antirabic treatment in Bagdad, and my gratitude is especially due to Major John Morison, I.M.S., the Director of the Pasteur Institute at Kasauli, to whom I am beholden for the strain of fixed virus, rabbits, etc., also for invaluable advice and precise technical details which I have embodied in the compilation of this paper.

To Lieutenant-Colonel J. D. Graham, C.I.E., I.M.S., the Director of Health Services, Irak, who first initiated and proposed the scheme for a Pasteur institute in Bagdad, I am deeply indebted for much kindly assistance. Also to Colonel A. H. Morris, C.B.E., C.I.E., A.M.S., D.D.M.S., Iraq, who pushed the scheme through official channels and encouraged the enterprise in every way—my grateful acknowledgments are due.

Finally, I express my appreciation of the loyal assistance and good services rendered by Assistant Surgeon J. Dewey, I.M.D., of the Pasteur Institute, Kasauli, and the commendable devotion to duty with which my laboratory assistant, Corporal R. H. Welch, R.A.M.C., carried on his extra work during an exceptionally trying hot weather.

APPENDIX.

POINTS IN RABBIT BREEDING.

In a climate like that of Irak rabbits will not pair during the hot weather. The stock required for the whole year must be bred between the months from October to April.

The breeding stock should comprise about 30 does, which should be kept in separate hutches provided with dark nesting apartments, and 6 or 8 bucks which should also be kept separate or they will fight and kill each other. A working

418 *Rabies in Irak, and its Treatment by Carbolized Vaccine*

stock of about 150 animals should be maintained. They thrive best if allowed the run of fairly large cool basements, cellars or mud huts.

The following conditions regarding the breeding of rabbits should be observed :—

(1) Does and bucks not under six months, but under three years, must be selected for breeding.

(2) All does and bucks will be numbered, and a register showing particulars will be maintained.

(3) Does for mating will be placed and left in the same cage as the buck. Success or failure, i.e., accepts or refuses, is known within a minute or less.

(4) In the event of a success the doe will be tested on the tenth day with the same buck; if she refuses it means that pregnancy has occurred, and in which case the doe is not to be put to a buck again.

(5) In the case of a failure, the doe will be taken to the same buck the next day and if she refuses the second time without sufficient cause, she should be tried with a different buck at an interval of a day. If she refuses for a third time, she must be left alone for a fortnight.

(6) If does are seen carrying grass into the next compartment, the nest must not on any account be disturbed. The period of gestation is thirty days.

(7) Particular attention must be paid to the feeding and watering of the does which have littered, for if they are not fed well they are apt to kill their young.

(8) As the mothers kill the young which have been handled, the young must not be touched before they leave the nesting compartment, which is usually between second and third weeks. If the nesting compartment has to be opened for removal of a young one which has died, all manipulations must be done with a stick.

(9) The young are to be separated from the mother after six weeks, and let loose in a common run. Bucks and does to be kept apart when they are three months old.

(10) Does are not to be put to bucks before seven weeks after the date of last litter.

(11) Bucks are not to be used more often than three times a week, successes only counting.

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THE CLINICAL ASPECTS AND PATHOLOGY OF PRIMARY MALIGNANT DISEASE OF THE VERMIFORM APPENDIX.

BY BREVET LIEUTENANT-COLONEL H. MARRIAN PERRY,

Royal Army Medical Corps.

PRIMARY malignant disease of the vermiform appendix furnishes one of the frequent examples of the fact that the apparent rarity of many morbid conditions diminishes in direct proportion to the advance of scientific investigation and to the degree of attention directed to them. The earlier reported cases of malignant change in this structure were accidentally determined at post-mortem examination, later cases were observed at operation for excision of the organ for some chronic inflammatory condition, and, with the wider recognition that primary malignant neoplasms occurred in this structure, routine histological examination of removed appendices added to the number of recorded cases.

The occurrence of malignant growths in the vermiform appendix is, however, sufficiently uncommon to merit attention when undoubted cases of this nature are met with. For this reason, it is thought that a short account of two cases which have recently come within the experience of the writer may be of interest in directing attention to both the pathological and clinical aspects of neoplasms arising in this situation.

Before entering into any discussion on the nature and histological characters of the growths concerned, it will be convenient to outline the clinical history of the cases.

Case 1.—In this case the patient was first seen three weeks before the date of operation. He came under observation at that time as a case of doubtful appendicitis, and a history of recurrent attacks of pain, dating from a primary attack seven months before, was elicited. The exacerbations of pain and tenderness were not of a severe character and lasted for a variable time, but even in the quiescent periods there was discomfort felt in the appendix region. On examination there was distinct tenderness in the right iliac fossa, but no guarding of the abdominal wall. There was no tendency to nausea or vomiting, and all general symptoms of inflammatory disturbance, such as rise of temperature, increased pulse rate, etc., were absent. The condition was regarded as one of chronic appendicitis, and removal of the organ was advocated.

At operation, the appendix was readily found, it was not adherent to the surrounding structures; there was no indication of torsion of the meso-appendix, and, beyond a peculiar bulbous dilatation or swelling at its distal end, the organ did not differ from normal. No enlarged glands could be palpated in its neighbourhood.

The wound healed by primary union, and convalescence was uninterrupted.

420 *Clinical Aspects of Disease of the Vermiform Appendix*

The exact age of this patient is not available, but he was over 40 years. No record of the further history of the case has, up to the present, been communicated.

Case 2.—This patient first sought advice regarding attacks of abdominal pain and discomfort, and was considered to be a case of chronic appendicitis. He was obviously in indifferent health, being pale and somewhat emaciated. His chief symptoms were those of dyspepsia and abdominal pain, referred to the appendix region, which was not, even on deep pressure, very marked. An opaque meal was administered and the hollow viscera examined by X-rays, some delay in the caecal region being shown which supported the presumption of a chronic inflammatory condition of the appendix.

Laparotomy was performed and the organ was found to be thickened and fibrous, the fibrotic condition extending up to the caecum. No enlarged lymphatic glands could be palpated.

In view of the pathological report indicating malignant change in the organ, further operative interference was considered, but was thought inadvisable owing to the debilitated condition of the patient.

The wound healed readily and the patient left hospital much improved. The age of this case was 65 years.

No detailed after-history of the case is available beyond the fact that death followed an abdominal operation six months later. It is probable that recurrence of the malignant growth in the caecum had occurred, and that operation had been undertaken for its relief.

In both of the above cases it will be noted that the patients had suffered from recurrent attacks resembling in nature an ordinary appendicitis, and, further, that at the time of operation there was no suspicion of any malignant origin underlying the condition. The pathological appearances of the removed appendices will be considered later. It may, however, be mentioned here that in one case signs of chronic inflammation of the organ were present, whilst in the other case they were entirely absent. In the history of both cases the general clinical signs of inflammatory disturbance were not evident, an unusual clinical feature in chronic appendicitis.

The age period recorded for primary malignant change in this situation is rather earlier than was evident in these cases, which it will be observed originated between the ages of 40 and 65 years.

DISCUSSION ON THE PATHOLOGY OF THE NEOPLASMS IN THE ABOVE CASES.

Case 1.—Macroscopic Appearance :—The gross anatomy of the body of the appendix was normal, but at the extremity was located a rounded swelling about the size of a large pea. Evidence of inflammatory change was not obvious. On section of the organ, the lumen was patent in the greater part of its length, being, however, obliterated by a firm, fleshy, new

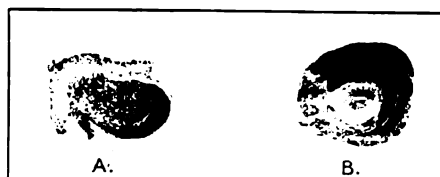


FIG. 1.—Sections of vermiform appendix from Case 1 (A) and Case 2 (B) $\times 2$.



FIG. 2.—Microscopic histology of growth from Case 1. $\times 350$.

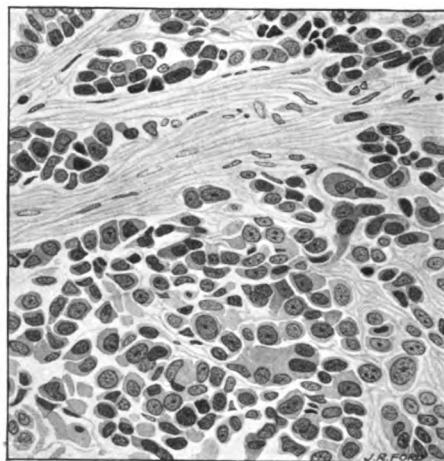


FIG. 3.—Microscopic histology of growth from Case 2. $\times 350$.

To illustrate "The Clinical Aspects and Pathology of Primary Malignant Disease of the Vermiform Appendix," by Brevet Lieutenant-Colonel H. MARRIAN PERRY, Royal Army Medical College.

growth at the tip. This new formation appeared to be confined to this situation and was of a pearly white colour (fig. 1A).

Microscopic Appearance.—Microscopic examination of sections classified the character of the malignant change in that interesting and controversial group of neoplasms, the *endotheliomata*.

The chief cause of difference of opinion in definition of growths of this type appears to lie in the recognition of the precise source of origin of the endothelial cells lining serous cavities, and of those forming the internal lining of lymph and blood vessels. The former are generally accepted as arising from cells of the coelomic cavity which is formed by early division of the mesoderm, the latter as originating from the mesenchymal layer and approximating more closely to the connective tissue type of cell. New growth arising from the serous lining cells may thus show certain carcinomatous attributes, whilst perverted growth of the internal lining of blood and lymph vessels may incline to a more sarcomatous appearance.

It is customary, however, to apply the term endothelioma to a group of tumours with certain characteristics which originate from the flat internal lining cells of blood vessels, lymph vessels, serous cavities, and subdural spaces. The most useful points of importance in the determination of growths of this class can be briefly stated. The prevailing type of cell may retain the flattened pavement character of the parent endothelium, but this feature may be entirely lacking owing to the distortion of the cells by pressure. Thus a polyhedral, spindle, or spheroidal-shaped cell may replace the more characteristic endothelial type. There are, however, certain characters inherent in the cells of new formations of this type which aid in its recognition. The cell-membrane is usually well defined, and the cytoplasm is clear and devoid of the granular opacity often evident in the cells of an epithelial tumour. The cell-nucleus is small, deficient in chromatin, and contains a number of minute nucleoli, contrasting markedly with the large, deep staining and irregular nuclei of malignant epithelial cells.

Various forms of grouping have been employed to denote especial types of endotheliomata, but the most generally serviceable and most readily applied relies on the arrangement in which the cells are disposed.

The cells in the growth under discussion conformed to the above description and were arranged in very definite alveolar formation, giving to the neoplasm an appearance somewhat akin to that of an adenoma. It would, therefore, be classified as an alveolar endothelioma. The disposition of the cells was in small and large groups separated by a well marked fibrous stroma. The entire absence of any attempt at formation of a lumen, the nature of the cells and their compact arrangement in solid alveoli, excluded the possibility of its confusion with an adenoma (fig. 2).

Endothelial growths of this type possess a very low degree of clinical malignancy, although pathological attributes of this nature are not wanting. Growth is usually slow and infiltrative in character, extension occurring

mainly by way of lymph capillaries and spaces. Insinuation of columns of cells between the interstices of the tissue cells of the part, as seen in the case of the carcinomata, does not usually occur, and involvement of lymphatic glands is, as a rule, exceedingly late or entirely lacking. The prognosis in this early case was, therefore, favourable, and extension to the cæcum or neighbouring lymphatic glands, with subsequent recurrence, would not be anticipated.

Case 2. Macroscopic Appearance.—In this case there was an entire dissimilarity in the naked-eye aspect of the appendix as compared with the condition instanced above. The organ was uniformly hypertrophied throughout its whole length, and felt rigid and fibrosed. The thickened condition of the serous coat and the numerous adhesions were evidence of the chronic peritoneal inflammation associated with the malignant change. On section of the appendix, the degree of hypertrophy of its walls could be better appreciated, as the lumen had been diminished to pin point diameter by the encroaching new growth (fig. 1, B).

Microscopic Appearance.—The contrast in histological structure of the neoplasm with that described in the former case, was as marked as the difference in macroscopic appearance of the organ.

The normal mucous membrane had entirely disappeared, and was replaced by a mass of fibrous tissue containing irregular islets and columns of cells of variable size arranged without any attempt at alveolar or glandular formation. These cells formed compact groups devoid of intercellular stroma and were of variable shape, but they generally approximated to a spheroidal type; they exhibited to a pronounced degree the malignant characteristics of reversion to embryonic cells which have been included under the term anaplasia. The cytoplasm of the cells was deficient in amount, and in many almost negligible. The nuclei were large, irregular in shape, and rich in chromatin, examples of atypical mitoses being frequent (fig. 3).

This new formation had extended almost uniformly around the appendix and had infiltrated the submucous and muscular coats which could not be differentiated from one another.

From the above cellular characteristics and from the fact that there was an excessive overgrowth of fibrous tissue, the neoplasm was defined as a *sclerosing spheroidal-celled carcinoma*.

It was not practicable, as is the case in the majority of recorded instances of this condition, to determine the exact site of origin of the new growth. In view of the very complete destruction of the mucosa, it is possible that it had originated from the Lieberkühn's glands in this situation.

Although in this case recurrence of the growth, probably in the cæcum, occurred, the prognosis of early spheroidal-celled carcinoma of the appendix is not unfavourable. Extension is, as a rule, slow, and there is no great tendency to lymphatic metastasis; early operative interference is, therefore, usually successful when the growth is confined to the appendix.

From a consideration of, at least, one of these cases, and from the literature of recorded instances of this nature, it is evident that primary malignant growth in this situation differs very considerably in its clinical course from cancerous changes in other tissues of the body. The neoplasm is very frequently entirely localized, at any rate in its early stage, and when infiltration does occur its extension is not rapid. In addition, although the early removal of the appendix, occasioned by the development of symptoms, may account for the absence of lymphatic metastasis, this form of dissemination does not appear to be usual.

How far the occurrence of chronic inflammatory change acts as an exciting agent in determining the incidence of growths of this nature is necessarily hypothetical. Both the chronic irritation of an appendicular stercolith, and the mechanical isolation of groups of cells caused by the cicatrization following on chronic obliterative appendicitis, have been suggested as factors in this connexion.

Whatever may be the cause, the fact that malignant change is not altogether uncommon in the vermiform appendix is an added incentive to the removal of this organ when symptoms of chronic inflammation become manifest.

I have to record my acknowledgment to Colonel J. W. West, C.M.G., K.H.S., and Captain E. Huntley, R.A.M.C., for providing the material on which these observations have been made, and for their kindness in permitting my reference to the notes of their cases.

A ROYAL ARMY MEDICAL CORPS STAFF TOUR IN EGYPT.

BY BREVET-COLONEL H. ENSOR, C.M.G., D.S.O.
Royal Army Medical Corps.

(Continued from p. 338.)

SECRET.

"Z" DIVISION R.A.M.C., ORDER No. 1.

Reference: Manœuvre Map of Desert East of Heliopolis.

February 6, 1922.

(1) The division attacks the enemy to-morrow, February 7, at zero hour.

(2) The enemy, estimated at a division, is holding the village of El Khusus; El Marg and El Birka.

(3) "A" infantry brigade has received orders to capture El Khusus; "B" infantry brigade El Marg; "C" infantry brigade El Birka.

The attack on El Khusus is being carried out by two battalions of "A" infantry brigade supported by a third battalion; that on El Marg by three battalions of "B" infantry brigade, one operating immediately to the west and the other two to the east of the railway line.

El Birka is being assaulted by two battalions of "C" infantry brigade with one battalion in support in the cutting of El Gebal canal.

(4) Each infantry brigade has received orders to send one battalion to form a divisional reserve which will come under the orders of Lieutenant-Colonel "Y" at 03.00 hours to-morrow, February 7.

This divisional reserve will, by 04.30 hours to-morrow, February 7, be in a position in the cutting of the El Gebal canal in squares D 46, 53 and 66.

(5) The battalions detailed for the attack have received orders to be formed up on our outpost lines by 04.30 hours to-morrow. The colonels commandant of the infantry brigades have agreed to issue orders to battalion commanders concerned that sites for regimental aid posts will be selected as detailed later in these orders.

(6) The C.R.E. has received orders to make crossings over the Taufiqiya canal at intervals of 500 yards from D 2.4—7.0 to D 9.0—8.4. This work will not be commenced before nightfall to-day.

(7) Officer commanding "C" field ambulance will be responsible for the collection of wounded from "A" infantry brigade and the two battalions of "B" infantry brigade which will attack El Marg immediately on the west and east sides of the railway line.

He will form an advanced dressing station with two tent sub-divisions in a house at the south end of the village of Arab-el-tawil at D 2.7—6.7 for the reception of wounded from the battalions of "A" infantry brigade.

Another advanced dressing station will be formed by his third tent sub-division in a house at D 4.1—6.8 for the reception of wounded from the two battalions of "B" infantry brigade which will attack El Marg immediately west and east of the railway line.

The regimental aid posts of the three battalions of "A" infantry brigade will be sited as follows:—

One in farm at D 2.7—7.5; another in dumping station at D 3.4—7.6; the third in the canal bank at D 2.8—7.2.

The regimental aid post of the battalion of "B" infantry brigade which will attack El Marg, west of the railway line, will be formed in the palm grove west of the road at D 4.3—7.4; that of the battalion which will attack immediately east of the railway line in the canal bank at D 5.4—7.1.

(8) Officer commanding "A" field ambulance will be responsible for the collection of wounded from the remaining battalion of "B" infantry brigade engaged in the attack on El Marg and of the wounded from the three battalions of "C" infantry brigade detailed for the assault on El Birka.

He will, with two tent sub-divisions, open an advanced dressing station in the buildings of the sewage pumping station in D 76 for the reception of wounded from the above mentioned battalions of "B" and "C" infantry brigades.

In addition he will also receive wounded brought to this advanced dressing station from the cavalry brigade which will operate on our right flank.

The cavalry field ambulance will, at zero hour, have opened a dressing station behind the old Suez railway embankment at F 3.5—7.2.

(9) The regimental aid posts of the battalion of "B" infantry brigade, whose wounded he is to receive, will be sited in a house in the south end of the village of Kafr-esh-Shurafa-esh-Sharqi at D 6.7—7.2.

The regimental aid posts of the two battalions of "C" infantry brigade which will begin the assault on El Birka, will be sited in the cutting of the El Taufiqiya canal at D 7.9—7.5 and at D 8.8—8.3.

The regimental aid post of the battalion of "C" infantry brigade in reserve will be in the cutting of the El Bebal canal at D 8.5—7.6.

(10) Ten trolleys are available for use in collecting wounded on the trolley line running north-east from the sewage pumping station. These trolleys are to be found at the sewage pumping station. Five others are on the trolley line near Kafr-el-Pasha but are required for the use of the cavalry field ambulance.

(11) The divisional walking wounded collecting post will be in a large red house surmounted by a dome at D 4.2—5.4. Officer commanding "A" field ambulance will staff this collecting post with his third tent sub-division.

(12) The divisional main dressing station will be in the Greek and

Egyptian schools on the main road from Zeitoun to Cairo in square D 21.

Officer commanding "B" field ambulance will be in command of this main dressing station and will staff it with his entire tent division.

Under arrangements made by D.D.M.S., 1st Corps, forty chronic venereal cases will report to him by 04.30 hours to-morrow, February 7, for duty in unloading and loading ambulance cars.

Officer commanding No. 1 motor ambulance convoy has received orders from D.D.M.S. to clear this main dressing station. Cases requiring immediate major operations are to be evacuated as early as possible to the Kasr-el-Aini Hospital, Cairo.

(13) Officer commanding "B" field ambulance will pack all surgical and medical material absolutely necessary for an advanced dressing station in sandbags (no full sandbag to be more than twenty pounds in weight).

The bearer division of "B" field ambulance is, by 04.30 hours to-morrow, February 7, to be in reserve behind the old Suez railway embankment as D 7.5—5.5. This bearer division will take with it a stretcher to every two men and will also carry with it the equipment done up in sandbags for use in forming an advanced dressing station when orders are received to do so.

(14) Dumps of spare stretchers will be formed by officer commanding "C" field ambulance at the following places :—

Fifteen stretchers at each of the five regimental aid posts which he is responsible to clear.

Fifty at the advance dressing station at D 2.7—6.7 and twenty-five at his advance dressing station at D 4.1—6.8.

Officer commanding "A" field ambulance will form a dump of twenty stretchers at each of the four regimental aid posts which he is responsible to clear and a dump of seventy stretchers at his advanced dressing station in the sewage pumping station.

Officer commanding "B" field ambulance will form a dump of sixty stretchers at the side of the road near the ostrich farm at D 3.4—4.5. This dump will constitute a divisional reserve of stretchers.

(15) Officer commanding field ambulances detailed to form advance dressing stations will ensure that a supply of sandbags are available for use in blocking up windows exposed to the enemy's rifle and shrapnel fire.

(16) No work is to be done in forming advanced dressing stations or dumps of stretchers before dark to-night. All work to be completed by 04.30 hours to-morrow morning, February 7.

(17) Clerical work at the advance dressing stations is to be reduced to a minimum. A field medical card is to be given to every man evacuated from an advanced dressing station but no particulars will be entered on this card. All that will be done at the advance dressing station will be that the officer who dresses the case will note on the card the nature of the injury and whether the case does, or does not, require redressing at the main dressing station.

The field medical cards will be completed and all other necessary clerical work carried out at the main dressing station. Anti-tetanic serum will also be given at this station and the fact recorded on the field medical card.

Field medical cards will be completed and anti-tetanic serum given to cases at the walking wounded collecting post before the cases are evacuated.

The divisional walking wounded collecting post will be cleared under arrangements to be made by "Q" branch of the Army headquarters.

Ten three-ton lorries, fitted up with seats, will be allotted for this purpose.

Officers commanding "A" and "C" field ambulances will each detail two clerks for duty at the main dressing station, and each one clerk for duty at the office of the A.D.M.S., at Abbasiya. The clerks detailed to report to the officer commanding main dressing station and to the D.A.D.M.S., respectively, at 18.00 hours to-night, February 6.

Army form W. 3210 (buff slip) will be made out for each man admitted to the main dressing station and the walking wounded collecting post, and these, at 12.00 hours and 18.00 hours, during every day the division is in action, will be sent by motor cyclist to the office of the A.D.M.S.

Officer commanding "B" field ambulance will send his admission and discharge books for officers and other ranks to the office of the A.D.M.S., by 18.00 hours to-night.

The D.A.D.M.S. will be responsible that the particulars of every officer and other rank given in the Army form W. 3210 are recorded in the admission and discharge books, and that A.F.A. 36 is made out from the admission and discharge book and forwarded daily to the D.A.G., 3rd Echelon at Army headquarters.

Army forms W. 3210 when no longer required, will be arranged in bundles, by units, and the bundles sent to each officer commanding for his information as regards the casualties his unit has sustained.

A list of casualties, by units, will be sent by the D.A.D.M.S., daily, while the division is in action, to the A.A. and Q.M.G., "Z" Division office at 22.00 hours. The names of officers will be given and the total numbers of other ranks.

Officers commanding advanced dressing stations will be responsible that the particulars of all officers and other ranks who are brought in dead, or who die at the advance dressing stations, are recorded on Army form W. 3210, and are sent to the officer commanding main dressing station. Such Army forms will have on them the word "died," and the designation of the advanced dressing station will be given on the top of the Army form. These will be forwarded by the officer commanding main dressing station to the office of A.D.M.S., at the same time as the other Army forms W. 3210 are sent in.

(18) A divisional motor ambulance convoy, consisting of all the large ambulance cars of the divisional field ambulances, will be formed for

the duty of clearing the advance dressing stations into the main dressing station.

The officer commanding "B" field ambulance will detail an officer to be in charge of this divisional motor ambulance convoy. The headquarters of this divisional convoy will be at a house on the road at D 3.2—4.0.

Officers commanding field ambulances will detail all their large motor ambulance cars to report to the officer commanding convoy at this place by 03.00 hours to-morrow morning, February 7.

By 04.30 hours to-morrow morning the officer commanding convoy will arrange that there are two cars at or near the advanced dressing stations opened by "A" and "C" field ambulances.

Car posts, each of two large ambulance cars, will be found at the following places:—

On track at D 4.5—5.5.

On road at D 3.4—5.6

The car post at D 4.5—5.5 will, on demand, provide a car for removing serious cases from the walking wounded collecting post. The remaining cars will be formed into a rank on the road near the headquarters convoy.

A loaded car coming from an advanced dressing station must pass one of the car posts. When it passes, or is sighted, one of the cars at the car post concerned will immediately proceed forward to take the place of the loaded car at the advanced dressing station from which it has come.

All loaded cars on their way to the main dressing station must take the road which will take them past the headquarters of the divisional motor ambulance convoy; when they pass this point they will inform the officer commanding, or his representative, as to the advanced dressing station from which they have come.

The officer commanding will then immediately send one of his empty cars from his car rank to take the place of the car which has proceeded from the car post to the advanced dressing station.

Cars after unloading at the main dressing station will return as soon as possible to the headquarters of the divisional motor ambulance convoy.

Officer commanding main dressing station will be responsible that all equipment, such as stretchers, blankets, splints, etc., removed from cars with patients are replaced at once under arrangements made by him.

Each motor ambulance car in the division is to be provided with a spade and twelve empty sandbags for use, if necessary, in filling in shell holes on the roads and tracks used by them.

The Ford ambulance cars and horsed ambulance wagons of "A" and "C" field ambulances, less the Ford car of "A" field ambulance, detailed for duty at an artillery aid post, will be disposed of by the officers commanding concerned to assist the bearer divisions in collecting wounded.

The horsed ambulance wagons of "B" field ambulance will, at 04.30 hours to-morrow morning, be drawn up off the road at D 1.8—3.4.

The Ford car not detailed for duty at the artillery aid posts will be retained by officers commanding for intercommunication.

The officer commanding divisional supply column has agreed to detail one officer and four mechanics with a repair lorry to report at the headquarters divisional motor ambulance convoy at 04.30 hours to-morrow to carry out running repairs to the ambulance cars.

Officer commanding "B" field ambulance will detail one motor cyclist to report to officer commanding divisional convoy at 04.30 hours to-morrow for duty. This cyclist will patrol the roads leading to the advance dressing station and report all cars broken down or disabled by shell fire.

(19) The Royal Artillery aid posts will be formed at the following places :—

In house at D 2.1—5.7; behind Suez railway embankment at D 5.7—4.3; behind Suez railway embankment at D 8.2—5.7

Officer commanding "B" field ambulance will detail one of his Ford motor ambulance cars to report to the aid post at D 2.1—5.7, and another to the aid post at D 5.7—4.3 by 04.30 hours to-morrow morning.

Officer commanding "A" field ambulance will provide a Ford ambulance for the aid post at D 8.2—5.7 by the same time to-morrow morning.

These cars will, on reporting, come under the orders of the R.A.M.C. officers in charge of the aid posts who will locate them in suitable situations, having due regard to the accessibility of their aid post to motor transport.

Wounded collected will be evacuated by these cars direct to the main dressing station.

In the event of heavy casualties assistance is to be applied for from the headquarters of the divisional motor ambulance convoy at D 3.2—4.0.

(20) Officers commanding "A" and "C" field ambulances will arrange that the transport of their units will be loaded up with all equipment, etc., not in use, and will be parked off the road at D 0.4—0.7 ready to move at short notice.

Horses will not be hooked in.

The transport of these units will be under the command of their quartermasters.

The transport of "B" field ambulance will be parked in some convenient site selected by its officer commanding. The wagons will be loaded with all equipments, etc., not in use.

(21) Officers commanding "A" and "C" field ambulances will inform A.D.M.S. before 20.00 hours February 6, where they will make their headquarters during the action to-morrow.

(22) The A.D.M.S. will, at 03.00 hours to-morrow, February 7, be at divisional advanced headquarters at Matariya in house on road at D 2.7—5.0.

Messages and reports to be sent to him there after 03.00 hours to-morrow.

The D.A.D.M.S. will remain at rear headquarters at Abbassiya at A 0.6—5.6.

(23) Zero hour will be communicated to officers commanding field ambulances later.

(24) Acknowledge.

Colonel.

O.C. R.A.M.C., "Z" Division.

Issued at 13.00 hours.

Distribution of copies as per overleaf.

NARRATIVE No. 1, FEBRUARY 7.

Copy No. 1.	"G," "Z" Division.
" "	2. "Q" Division.
" "	3. "A" Field Ambulance.
" "	4. "B" " "
" "	5. "C" " "
" "	6. "A" Infantry Brigade.
" "	7. "B" " "
" "	8. "C" " "
" "	9. C.R.A.
" "	10. C.R.E.
" "	11. D.D.M.S., Corps.
" "	12. D.M.S., Army.
" "	13. Headquarters, Cavalry Brigade.
" "	14. O.C., Cavalry Field Ambulance.
" "	15. {
" "	16. { File.
" "	17. }

SECRET.

O.C., "A" Field Ambulance.

O.C., "B" " "

O.C., "C" " "

Zero hour will be at 05.15 hours to-morrow, February 7.

Acknowledge.

Colonel.

"A.D.M.S., "Z" Division.

Issued at 23.00 hours, February 6,
by Motor Cyclist Orderly.

NARRATIVE No. 1.

07.30 hours.

The attack on El Khusus has been held up. The two battalions of "A" infantry brigade which began the attack have reached a line D 2.3—8.8 to D 3.7—8.6.

The supporting battalion of "A" infantry brigade has advanced to the line D—2.4—8.1 to D 3.1—8.1.

The attack on El Marg has been successful, and the enemy after heavy fighting at close quarters has been driven from the village and palm groves. Our casualties and the enemy's are reported to be very heavy. Many prisoners have been taken.

The defeated enemy for the most part retired in the direction of El Qalag, but many retired towards the village of El Manaiya in Square H 31.

The battalions of "B" infantry brigade which attacked immediately east of the railway are on a line D 5.0—9.0 to D 5.9—9.0.

Scouts report the buildings at H 5.5—0.0 to be held by the enemy. The other two battalions of "B" infantry brigade are re-organizing and taking up positions east and west of El Marg.

The assault on El Birka was rapidly successful, and our casualties are not heavy. The reserve battalion of "C" infantry brigade was not used.

The enemy retired in two directions—one party along the line of the Belbeis drain to El Qalag, and the other party along the eastern bank of the swamp Birket-el-Hag.

Prisoners report that El Khusus is held by two battalions, and the same number of battalions held El Marg and El Birka.

Two battalions are said to be in the El Qalag area.

The enemy reserves are said to be in the El Qalag area.

The report that the enemy has two cavalry regiments only is confirmed.

NARRATIVE No. 2.

09.00 hours.

Information has been received that the squadron of "A" cavalry regiment in the palm groves near Abusir tried to charge the enemy infantry retreating along the east side of the swamp. The enemy rallied under their officers and the charge was repulsed by rifle fire with a loss of seven killed and twenty-seven wounded to the squadron of "A" cavalry regiment.

It is also reported that an enemy cavalry regiment advanced from J 12 to cover the retirement of their infantry. The three squadrons of "A" cavalry regiment from square F 28 engaged this cavalry regiment, and a cavalry combat took place in square J 21 which resulted in the enemy cavalry regiment being dispersed in the direction of Khanka. The retiring hostile infantry were again approached by our cavalry, but were evidently well under control of their officers, and no charge was made on them, and they succeeded in retiring to El Qalag, though they suffered heavily from the shrapnel fire of the R.H.A. battery.

The enemy cavalry regiment, which was at daybreak in Square J 43, was engaged about 08.00 hours by "B" and "C" cavalry regiments, and retired in disorder in a northerly direction.

The cavalry brigade has received orders from corps headquarters for "A" cavalry regiment to watch the ground between the swamp and the

Khanka sewage disposal works, while "B" and "C" cavalry regiments are to work to the north and try to strike at the enemy's communications.

NARRATIVE NO. 1. FEBRUARY 7. MEDICAL ARRANGEMENTS.

07.30.

The R.A.P.s of the two leading battalions of "A" infantry brigade have moved forward, and are established in farm buildings at about D 2.5—8.3 and D 3.5—8.2 respectively.

The R.A.P. of the supporting battalion has moved forward to the farm formerly occupied as a R.A.P. at D 2.7—7.5.

Officer commanding "C" field ambulance has got bearers in the R.A.P.s at D 2.5—8.3; D 3.5—8.2, and D 2.7—7.5. He has taken over the former R.A.P. in pumping station at D 3.4—7.6, and the R.A.P. first formed by the supporting battalion in the canal bank at D 2.9—7.2 as relay posts for his bearers.

The R.A.P.s of the three battalions of "B" infantry brigade have moved forward and are established in houses in El Marg.

Officer commanding "C" field ambulance reports that he has occupied the R.A.P. of the battalion, which attacked immediately to the west of the railway line, as a relay post, and has got squads of bearers up to the R.A.P.s of this battalion now formed in El Marg, and that of the other battalion of "B" infantry brigade, whose wounded he is responsible to clear.

He also reports that wounded are coming in well to both his advanced dressing stations, and that these dressing stations are being kept clear by the cars of the divisional motor ambulance convoy.

The road from his A.D.S. at D 4.1—6.8 to El Marg is reported blocked by fallen trees. One field company, R.E., is engaged in clearing the road, and it is estimated that the road will be passable for wheeled transport in about an hour.

When it is, he will send his two Ford ambulance cars and his three horsed ambulance wagons, with tilts removed, into El Marg to clear wounded direct from the R.A.P.s established there. He is already using horsed ambulance wagons to clear his relay post into the A.D.S. at D 4.1—6.8.

Officer commanding "C" field ambulance reports that his R.A.M.C. casualties are two other ranks killed and seven wounded.

Officer commanding "A" field ambulance reports that all is well, and that his advanced dressing station is being cleared normally. He has by means of the trolley line rapidly cleared the wounded of "C" infantry brigade.

He has got into touch with the R.A.P. of the battalion of "B" infantry brigade, whose wounded he is responsible to clear. He reports that many wounded still remain to be cleared in the palm groves, in squares D 67 and D 57, but that he is clearing these by employing all his bearer division

with the exception of three squads on duty on the trolley line, and one squad at each of the R.A.P.s of "C" infantry brigade.

He has sent his three-horsed ambulance wagons loaded with spare stretchers across the canal at D 5.7—7.1, with orders to proceed as far forward as possible up the track leading to El Marg in square D 57. The drivers have orders, when their wagons are fully loaded, to take the wounded to the A.D.S. at D 4.1—6.8.

He reports that the walking wounded collecting post is functioning normally. His R.A.M.C. casualties are one regimental medical officer killed, and one of his bearer officers severely wounded, one other rank has been killed and three wounded.

The following orders were issued by A.D.M.S., "Z" Division, when he received the above information.

(1) Orders to officer commanding "C" field ambulance to ensure that his Ford cars and horsed ambulance wagons, when able to get to El Marg, take with them twenty-five spare stretchers from the dump at D 4.1—6.8, and any stretchers remaining at the relay post at D 4.3—7.4.

(2) Orders to officer commanding divisional convoy to order the next three cars returning empty to the car post at D 3.7—5.7, to each take ten stretchers from the reserve dump at the side of the road near the ostrich farm at D 3.4—4.7. These stretchers to be dumped at the A.D.S. at D 4.1—6.8.

(3) Orders to officer commanding "A" field ambulance to hold in readiness one tent sub-division at his A.D.S. at the sewage pumping station to go forward to open an advanced dressing station in some suitable place in El Marg. The necessary equipment packed in sandbags will be supplied by officer commanding bearer division "B" field ambulance.

(4) Orders to officer commanding bearer division "B" field ambulance to send the equipment for an advanced dressing station to the advanced dressing station at the sewage pumping works.

(5) Orders to the horsed ambulance wagons of "B" field ambulance at D 1.8—3.4 to move forward and halt for orders on the road near the reserve stretcher dump at D 3.4—4.7, and to load up with ten stretchers each.

(6) Orders to C.R.E. to detail his R.A.M.C. officer to report forthwith to the officer commanding advance dressing station at the sewage disposal works for duty with the battalion whose R.A.M.C. officer has been killed.

Orders to officer commanding divisional train to detail his medical officer to report to the same advance dressing station to replace the wounded officer of bearer division "A" field ambulance.

(7) Signal message to D.D.M.S. reporting R.A.M.C. officer casualties, and asking for them to be replaced.

(8) Orders to officers commanding advanced dressing stations each

to detail twenty unwounded prisoners for duty in loading and unloading ambulance wagons. Escorts to be found by slightly wounded soldiers.

General officer commanding approves of this.

Copy of message to A.P.M.

NARRATIVE No. 2. FEBRUARY 7. MEDICAL ARRANGEMENTS.

09.00 hours.

Officer commanding cavalry field ambulance had before zero hour opened a small A.D.S., near the trolley line at Abusir, and taken over the five trolleys allotted to him.

With the aid of these trolleys the wounded from the squadron of "A" cavalry regiment were brought quickly to the A.D.S., at the sewage pumping station.

The advance of "A" cavalry regiment (less one squadron) and "B" and "C" cavalry regiments, was followed up by two light horsed ambulance wagons with tilts removed, to each regiment; each ambulance wagon containing six bearers.

An A.D.S. was formed near the track at F 2.5—9.8 by 08.00 hours, the necessary equipment having been carried forward in the ambulance wagons detailed to "B" cavalry regiment.

The Ford ambulance cars were, later, sent forward to this A.D.S.

The wounded from the cavalry combat in square J 21 were moved by the horsed ambulance wagons to the A.D.S. at F 2.5—9.8 and then along the track, Darab-el-Hag, to the A.D.S. first opened near Abusir, by the Ford ambulance cars.

From thence they were moved by trolley to the A.D.S. in the sewage pumping station.

The casualties sustained by "B" and "C" cavalry regiments were chiefly from shrapnel fire during the advance, and were collected by the horsed ambulance wagons which followed up the advance.

No casualties were sustained by these two regiments from the "armes blanches."

NARRATIVE No. 3.

08.00 hours.

Orders have been sent from "G" advanced headquarters for two battalions from the divisional reserve to proceed forthwith to El Marg, where they will come under the orders of colonel commandant, "B" infantry brigade.

One of these battalions is to get into position to attack El Khusus from the east; the other battalion is to advance astride the railway line and capture the buildings at H 5.0—0.0. The battalion of "B" infantry brigade on the line D 5.0—9.0 to D 5.9—9.0 will support this attack.

The fresh attack on El Khusus will be carried out by "A" infantry brigade and the battalion from the divisional reserve, at 10.00 hours.

The attack on the buildings held by the enemy at H 5.5—0.0 will take place at the same hour.

Information has been received that the attack of our two divisions on the west of the Ismailia canal has been successful.

They have taken their first objectives.

NARRATIVE No. 4.

11.30 hours.

The renewed attack on El Khusus has been entirely successful, though at heavy cost. The enemy retired in the direction of El Manaiya.

One battalion of "A" infantry brigade is in and round El Khusus with two battalions to the north of this village on a line from H 2.6—0.4 to H 3.9—0.2.

The battalion ordered to attack El Khusus from the east suffered very little loss, as El Khusus was captured by "A" infantry brigade before it could develop its attack.

This battalion has received orders to get into position in advance of the two battalions of "A" infantry brigade on the line given above to the north of El Khusus.

The attack on the enemy in position round the buildings at H 5.5—0.0 was successful at first without much loss, but before the two battalions which took part in it could be completely reorganized, the enemy counter-attacked with two battalions along both sides of the El Marg and El Qalag road.

Heavy fighting took place before the enemy was finally repulsed. Our casualties and those of the enemy are very heavy.

Orders have been sent to Colonel Commandant "A" infantry brigade to prepare to advance and capture El Manaiya. The attack is to take place before 13.00 hours.

Aeroplane reports are to the effect that the enemy appears to be withdrawing transport to the north, and that there are many fugitives on the roads to the rear of his position.

NARRATIVE No. 3. FEBRUARY 7. MEDICAL ARRANGEMENTS.

08.00 hours.

The R.A.P.s of "A" infantry brigade and the R.A.P.s of the battalions of "B" infantry brigade in El Marg have not moved. The same is true of those of "C" infantry brigade. Officer commanding "C" field ambulance reports that he has succeeded in getting his horsed ambulance wagons to within 500 yards of El Marg and is clearing all the R.A.P.s in El Marg.

Officer commanding "A" field ambulance reports that he is still engaged in clearing the casualties in squares D 67 and D 57. He reports the arrival of many wounded from our cavalry brigade on our right and the receipt of the equipment for an advanced dressing station.

The following orders sent by A.D.M.S.

(1) Order to officer commanding "A" field ambulance to send forward his tent sub-division to open in El Marg.

(2) Orders to officer commanding "B" bearer division to take his men squad by squad from his present position to the cutting of the El Gabal canal at D 4.2—6.3 and to await orders there.

(3) Message to officers commanding "A" and "C" field ambulances informing them of the orders issued to two battalions of the reserve to proceed to El Marg.

09.00 hours.

Information received from officer commanding "C" field ambulance that his Ford cars and horsed ambulance wagons have reached El Marg and that by these means he has cleared all the wounded remaining in the village itself to his advanced dressing station which is becoming congested with wounded. Reserve stretchers have arrived carried up by ambulance cars from divisional motor ambulance convoy. He has sent to the officer commanding this convoy a message by a returning loaded car asking for more cars to clear his A.D.S. at D 4.1—6.8.

Wounded are coming in very slowly into his A.D.S. south of Arab-el-Tawil and D 2.7—6.7, and his information is to the effect that large numbers of our wounded are lying in the cultivation unable to be moved owing to the heavy rifle fire.

Orders issued by A.D.M.S.

(1) Orders to non-commissioned officer in command of three horsed ambulance wagons of "B" field ambulance to proceed to Ain Shams and report to officer commanding advanced dressing station at south end of village of Arab-el-Tawil for orders.

(2) Orders to officer commanding "A" field ambulance to send his available Ford ambulance cars to report to officer commanding advanced dressing station at Arab-el-Tawil for orders.

(3) Message to officer commanding "C" field ambulance informing him of the above orders and to tell him that his transport is to be used to clear the wounded incidental to the renewed attack on El Khusus when the time comes.

(4) Orders to officer commanding "A" field ambulance to take over the duty of collecting wounded from the five battalions in position in the El Marg area from officer commanding "C" field ambulance. Transport of "C" field ambulance engaged in clearing wounded from El Marg to come under his orders. Information to be sent to A.D.M.S. immediately the A.D.S. is opened in El Marg.

Bearers of "C" field ambulance relieved by "A" field ambulance to report to officer commanding "C" field ambulance for duty in collecting wounded in the El Khusus Areas.

Copy of these orders to officer commanding "C" field ambulance for his information.

NARRATIVE NO. 4. FEBRUARY 7. MEDICAL ARRANGEMENTS.
12.00 hours.

Officer commanding "C" field ambulance reports that he has very many wounded to remove from squares D 28 and D 38 and requires assistance.

He has ordered the horsed ambulance wagons of "B" field ambulance and the Ford cars of "A" field ambulance placed at his disposal across the canal, loaded with all available stretchers, on to the track leading to El Khusus from Arab-el-Tawil and is employing all his available men to collect wounded and bring them to this track.

The R.A.P.s of "A" infantry brigade and battalion from divisional reserve are located in and about El Khusus but he can spare no squads of bearers for them.

The following order is issued by A.D.M.S.

Officer commanding bearer division "B" field ambulance will proceed immediately with his entire division to report to officer commanding advanced dressing station at south end of Arab-et-Tawil (D 2.7—6.7) for duty in collecting wounded of "A" infantry brigade.

He will, on arrival, come under the orders of officer commanding "C" field ambulance.

Officer commanding "A" field ambulance reports that he is clearing the wounded from the attack on the buildings at H 5.5—0.0 and that he is able to clear the R.A.P.s of the two battalions which delivered the attack by means of the Ford cars and horsed ambulance wagons.

The large cars of the divisional motor ambulance convoy are not clearing the advanced dressing station in El Marg.

Orders sent by A.D.M.S. are the following:—

(1) Order to officer commanding "C" field ambulance to withdraw all the personnel of his A.D.S. at D 4.1—6.8, except one officer and three other ranks, to his A.D.S. at south end of Arab-el-Tawil and to send forward one of his tent sub-divisions to establish an A.D.S. in El Khusus as soon as he is able to do so. It is understood by A.D.M.S. that owing to the great number of wounded he is at present dealing with, that it may not be possible for an A.D.S. to be opened in El Khusus for some time, but every effort is to be made to open it before 13.00 hours to-day.

Information also sent to him that "A" infantry brigade will attack El Manaiya at 13.00 hours to-day.

NARRATIVE NO. 5.

04.50 hours.

Information received that an infantry brigade, with one brigade R.F.A. and one field ambulance from the unused division in reserve has arrived at Matariya and is marching to reinforce "Z" Division.

The attack on El Manaiya has been successful. The enemy retired without much resistance behind the Belbeis drain. Our casualties were

but slight. An entire brigade of field artillery was found abandoned by the enemy about half way between El Khusus and El Manaiya.

Information has been received that the division on our left west of the Ismailia canal is advancing and has reached a line approximately from the Ismailia canal bank at H. 2.9—2.7 to the west. The villages of Siriaqus (H 3.6—3.7) and Orban Foda (H 5.8—3.8) are on fire.

The enemy's artillery fire has died down on our front until it is almost negligible. Scouts report the line of the Belbeis drain to be strongly held from El Qalag to the north-west.

Cavalry patrols attempting to reconnoitre in the direction of El Qalag from the east are always heavily fired on from the buildings at J 0.6—2.3.

Orders have been issued from divisional headquarters for the two battalions of "C" infantry brigade to advance to the east of the trolley line running to the Khanka sewage farm and to attack El Qalag from the east.

The remaining battalion of "C" infantry brigade and the remaining battalion from the divisional reserve have received orders to advance on El Qalag from the south astride of the Belbeis drain.

"A" and "B" infantry brigades have also received orders to advance. "A" Infantry brigade to attempt to cross the Belbeis drain and capture Orban Foda. "B" infantry brigade is to advance on El Qalag astride the road and railway.

The attack of "A" and "B" infantry brigades is timed to begin at 14.00 hours; that of "C" infantry brigade at 15.00 hours.

Aeroplanes report that the enemy is obviously retiring. The roads and tracks to the north of his position are crowded with transport. There are hundreds of fugitives.

17.00 hours.

"A" infantry brigade has succeeded in crossing the Bilbeis drain, has captured Orban Foda, and reports that the enemy are retreating in disorder in all directions.

Orban Foda was not occupied by the enemy. The casualties are slight.

The enemy in El Qalag area for a time held up the attack of "B" infantry brigade, but as soon as the attack of the two battalions of "C" infantry brigade from the east developed, his troops surrendered.

The infantry brigade sent as a reinforcement has arrived at El Qalag and has received orders to pursue the retreating army.

18.00 hours.

The cavalry brigade reports that at 16.00 hours it captured Abu Zabal and has cut off a large amount of transport which was retiring north.

Abu Zabal was captured by a dismounted attack of "B" cavalry regiment and sixty casualties were sustained.

"C" cavalry regiment has moved to intercept fugitives and transport attempting to escape between Abu Zabal and the Ismailia canal.

NARRATIVE NO. 5. FEBRUARY 7. MEDICAL ARRANGEMENTS.

15.00 hours.

Officer commanding "C" field ambulance reports that he believes all the wounded in El Khusus area have been collected. He was able to open an A.D.S. in El Khusus soon after 12.30 hours.

The bearers of "B" field ambulance have followed up the advance of "A" infantry brigade on El Manaiya with horsed ambulance wagons with tilts removed, on the track leading from El Khusus to El Manaiya. Only one loaded wagon has returned to the A.D.S. at El Khusus and the few walking wounded who have passed through the village state that the enemy is on the run.

He has also just received a message from officer commanding "B" bearer division to state that he is in El Manaiya and has got into touch with the R.A.P.s of the battalions of "A" infantry brigade.

He has formed a bearer collecting post in El Manaiya and will clear it with the horsed ambulance wagons he has got with him, but is of opinion that he will require two Ford cars as he has received information that a further advance to attempt the crossing of the Bilbeis drain will be made shortly.

The A.D.M.S. will issue the following orders and messages :—

(1) Orders to officer commanding "A" field ambulance informing him of the attack to be made by "B" and "C" infantry brigades. Officer commanding "A" field ambulance to form bearer collecting stations at the buildings at H 5.5—0.0 and at El Birka when the advance on El Qalag begins.

The horsed ambulance wagons of his unit are to accompany the march of the two battalions of "C" infantry brigade detailed to attack El Qalag from the east. As many bearers as can be spared are to accompany these ambulance wagons which will carry spare stretchers in them. Officer commanding "A" field ambulance is also to hold his tent sub-division in the A.D.S. at the sewage pumping station in readiness to proceed to El Qalag to open there when this position is captured.

(2) Message to officer commanding "C" field ambulance congratulation and approval of the arrangements to deal with the casualties expected as a result of the coming attack of "A" infantry brigade, on the Bilbeis drain.

17.50 hours.

Officer commanding "A" field ambulance reports that he is clearing the wounded from the successful attack on El Qalag rapidly by means of prisoners to the bearer collecting station in buildings at H 5.5—0.0.

The wounded from the two battalions which advanced on El Qalag

astride of the Bilbeis drain are being sent to the A.D.S. at El Marg ; he is making use of prisoners for this purpose also.

He has received information that the road to El Qalag is practicable for wheeled transport.

A bearer collecting post was formed on the trolley line at J 2.0—1.1 for the wounded of the two battalions which attacked El Qalag from the east. Wounded collected there to be taken by trolley to the sewage pumping station. He is informed that our casualties in this area are not heavy.

The following orders issued by A.D.M.S. :—

(1) Officer commanding "A" field ambulance to move his tent sub-division at the sewage pumping station to El Qalag to open an A.D.S. there. One officer and five other ranks to be left at the sewage pumping station to receive any wounded that may yet arrive at this dressing station.

(2) Messages to officers commanding field ambulances to the effect that a reserve infantry brigade has arrived from Matariya and is now at El Qalag to take up the pursuit of the defeated enemy. Applications has been made to Headquarters "Z" Division for parties from the fighting troops to search thoroughly the ground over which the fighting has taken place and to bring wounded found to the nearest place where assistance can be obtained.

Officers commanding field ambulances to detail R.A.M.C. officers to accompany such parties when required to do so.

All dressing stations to remain open until further orders and the evacuation to the main dressing station to continue as at present until further orders.

10.09 hours.

Information has been received that the cavalry field ambulance has established a dressing station at Abu Zabal and will send their wounded to El Qalag by means of their own ambulance transport.

THE ELEMENTARY PRINCIPLES OF ZOOLOGICAL NOMENCLATURE.

BY BREVET LIEUTENANT-COLONEL W. P. MACARTHUR.
Royal Army Medical Corps.

THESE notes on zoological nomenclature do not concern those who have had the advantage of systematic instruction in any branch of medical zoology and who consequently are familiar with the principles involved. Some medical officers, however, find it necessary or advantageous to employ scientific names of insects, worms, or more lowly animals, in the course of their work, and having no clear idea of the significance of the names they use, nor of the reasons for their adoption, they feel bewildered by the whole subject. At the request of several officers who have found themselves in such a situation, I have written this article in the hope of assisting them, and perhaps others similarly placed. I hasten to add that I do not pose as an authority on zoological nomenclature, having studied the subject no more deeply than has proved necessary for everyday work. It seems strange that a matter which amply repays consideration should so often be neglected. Many men who make no claim to be chemists, for instance, would feel disconcerted and ashamed if detected in the misuse of a formula, or in some other chemical solecism, and yet they continue to maltreat zoological terminology in a harrowing fashion, without a qualm—nomenclature is a knavish business, but we who have free souls it touches us not! Teachers in hospital wards and out-patient departments are often to blame for this distressing state of affairs, for their lectures on conditions due to parasites rarely include any explanation of the system of nomenclature, and indeed they themselves often employ incorrect names which their unfortunate students have subsequently to unlearn. I found that some of the members of a recent class of instruction had never heard of crab lice and itch mites during their medical training except under the names "*Pediculus*" *pubis* and "*Acarus*" *scabiei* respectively. When they were constrained to acquire the correct nomenclature of these parasites there was some good-natured grumbling about "the continual changing of names." Now since the crab louse was placed in the genus *Phthirus* by Leach in the year 1815, and the genus *Sarcoptes* was founded by Latreille in 1806, any justifiable complaint of inconvenience from these alterations lay not with the members of the class, but with their great-grandfathers. Writers of textbooks of medicine and of hygiene are also often culpably careless in their use of names. For example, how often do we see the worm causing trichinosis described as "*Trichina*" *spiralis*, although this generic term was rejected long ago.

Medical men often complain bitterly of the alteration of zoological names—and certainly some workers propose changes for reasons that seem

strained and inadequate—but much of the trouble experienced by medical men in this respect is due to our retention and perpetuation of names which are long dead and should have been decently buried years ago.

The present scientific binominal nomenclature was inaugurated by Linnæus, of glorious, pious and immortal memory, in his *Philosophia Botanica*, published in 1751, but this method was not systematically introduced for the animal kingdom until 1758 when the same author published the famous Tenth Edition of the *Systema Naturæ*. For many years Linnæus' rules sufficed for all requirements, but more modern thought and the advancement of science led to various attempts to modify and improve them. Thus Strickland's Rules were drawn up in 1842-43 by a Commission which included Darwin amongst its members. The Zoological Society of France issued a code in 1881; the German Zoological Society did likewise some years later; and other series of rules were formulated in America and elsewhere. These amplifications of the Linnæan system, however excellent in themselves, were open to grave objection, for most embraced only a portion of the zoological range, and above all, none of them had any international status. To cope with a state of affairs already unsatisfactory and threatening to become worse, Professor Blanchard submitted a report to the First International Congress of Zoology held at Paris in 1889, in which he advocated the adoption of a suggested international code. The question was debated again at the Second Congress at Moscow in 1892, when Blanchard's proposed code was adopted with little alteration as the International Rules of Zoological Nomenclature. The Third Congress at Leyden in 1895 nominated an International Commission on Zoological Nomenclature, and the Fourth Congress at Cambridge in 1898 made this International Commission a permanent body. Official copies of the Code were prepared in French, English and German, but in the event of any discrepancy in meaning, or any variation in the texts, the French version is to be taken as authoritative. Any proposed amendment to the Rules has to be notified to the Commission on Nomenclature one year before the International Congress assembles. Therefore our employment of a zoological name, whether that of a prehistoric monster or that of a malaria parasite, is controlled and guided by the International Rules, and the Recommendations under the Articles; the Appendix to the Code; and a series of Opinions pronounced by the learned International Commission for guidance in interpretation of the Rules. All this sounds very formidable, but as a matter of fact, what most of us require to know on the subject can be learned easily in half an hour.

Before dealing with any of the actual rules, it might be well to touch on some elementary points explanatory of the method of classification adopted for animals. To take the common fly, *Musca domestica*, as an example. All individuals included within the conception expressed by this term resemble one another in every specific point, other than such differences as are due to sex and to slight individual variation. Under suitable

conditions these flies will breed and produce fertile offspring. Consequently they are regarded as constituting a species, *M. domestica*. Now, when on a country jaunt on a warm day in England, we may be worried by the attentions of flies resembling *M. domestica* very closely, but more careful examination demonstrates constant differences between them. A comparison of the heads of the males, for instance, shows that the male *M. domestica* has a distinct space between the eyes, whereas the eyes of the male of the other fly are in close apposition. This, taken together with other constant differences, shows that we are dealing with a different species, in this case *Musca autumnalis*. But these two species, together with others, have in common the same wing venation, the same arrangement of certain bristles, etc., characters which are sufficiently distinct to be regarded as being of generic importance. So the species showing them are grouped together to form a genus, *Musca*. From this it is evident that the designation of a species consists of two parts, the name of the genus to which it belongs, combined with its own specific name. To proceed further, if the genus *Musca* is compared with the genus *Glossina* (tsetse flies), with *Stomoxys*, etc., these genera are found to have certain features in common, and so all which show these characters are grouped together in a Family—MUSCIDAE. By a similar method the MUSCIDAE are combined with other related families to form an Order—DIPTERA, and the DIPTERA are joined with other Orders (Fleas, Bugs, Lice, etc.), to form a Class, INSECTA. The INSECTA, together with the ARACHNIDA (Ticks and Spiders), and certain other classes, constitute the Phylum, ARTHROPODA, other phyla of medical interest, built up by similar grouping, being the parasitic Flat worms, parasitic Round worms, Snails, etc. And this pedigree carried back still further will ultimately join up with that of the more lowly animals, the Protozoa, the final assemblage constituting the animal kingdom.

For convenience in classification, divisions intermediate between these may sometimes be recognized—Suborders, Subfamilies, Subgenera, etc., and the individuals of a species, especially one which is large and widespread, may show small constant differences indicative of racial varieties or Subspecies.

We may now consider the rules of nomenclature so far as they concern us.

Article 2.—"The scientific designation of animals is uninominal for subgenera and all higher groups, binominal for species, and trinominal for subspecies."

Thus, human head and body lice belong to the genus *Pediculus*, the species is *Pediculus humanus*, and if desired to go further and contrast the two subspecies, or racial varieties, a trinominal designation is necessary, e.g., *Pediculus humanus corporis*. (Article 17 directs also that when a sub-specific name is cited it is to be written directly after the specific name without the interposition of any mark of punctuation.)

Article 3.—"The scientific names of animals must be words which are either Latin or Latinized."

Various directions are given in the body of the Code and in the Appendix for the Latinizing of barbarous and Greek words. For instance, the Greek terminal *os* has to become *us*, so that the name of the well known genus of ticks is correctly rendered *Ornithodorus*. There is no objection to the terminal Greek *a*, therefore it is unnecessary to Latinize the common *-stoma* to *-stomum*.

Article 4.—"The name of a family is formed by adding the ending *idae*, the name of a subfamily by adding *inae*, to the stem of the name of the type genus."

Thus from *Culex*, the type genus of the mosquito family, we have CULICINAE and CULICIDAE. The name commonly employed for the subfamily (or family), of the "soft" ticks is not in accordance with the foregoing article. The type genus is *Argas*, and since the stem of the Latinized *argas* (= shining) is *argant*, the subfamily should be ARGANTINAE not ARGASINAE.

Article 8.—"A generic name must consist of a single word, simple or compound, written with an initial capital letter, and employed as a substantive in the nominative singular."

Article 10.—"When it is desired to cite the name of a subgenus, this name is to be placed in parenthesis between the generic and specific names."

The author of a widely-used textbook of medicine writes the name of the itch-mite "*Sarcoptes (Acarus) scabiei*." Obviously he interposes "*Acarus*," lest any of his readers should fail to recognize the parasite under its correct name, but the meaning of the combination is far removed from what is intended. It must be interpreted as a division of the genus *Sarcoptes* into several subgenera, and in one of these (*Acarus*) the itch-mite is placed.

Article 13.—"While specific substantive names derived from names of persons may be written with a capital initial letter, all other specific names are to be written with a small initial letter."

Often advantage is not taken of the permission accorded in the first portion of this Article, for confusion has resulted between a personal specific name written with an initial capital and the name of the author. The specific term in *Filaria bancrofti*, for example, could be written with an initial capital, but it is desirable to use a small letter for the sake of uniformity, and to avoid possible confusion, especially when the names of Italian authors are cited.

Article 19.—"Under this Article there is the Recommendation: "For scientific names it is advisable to use some other type than that used for the text." As an illustration, an extract follows in ordinary print with the name of a species in italics, the name of the author being cited in roman type. Usually the names of groups higher than genera are not italicized, roman type being employed.

Article 22.—"If it is desired to cite the author's name this should

follow the scientific name without interposition of any mark of punctuation ; if other citations are desirable (date, etc.), these follow after the author's name but are separated from it by a comma or by parenthesis."

Article 23.—"When a species is transferred to another than the original genus, or the specific name is combined with any other generic name than that with which it was originally published, the name of the author of the specific name is retained in the notation but placed in parenthesis. If it is desired to cite the author of the new combination his name follows the parenthesis."

Pediculus humanus Linnæus, 1758, can be taken as an example under Article 22. Whereas (Article 23), *Phthirius pubis* (Linnæus, 1758) Leach, 1815, shows that Linnæus named this species but placed it in a different genus (*Pediculus*), from which it was removed to its present genus by Leach.

Article 25.—"The valid name of a genus or species can be only that name under which it was first designated on the condition:—

"(a) That the name was published and accompanied by an indication, or a definition, or a description.

"(b) That the author has applied the principles of binary nomenclature."

This is the all-important Law of Priority. As an example of its application, is *Bilharzia* or *Schistosoma* the correct generic name of the human blood fluke originally described by Bilharz as *Distomum hæmatobium*, but subsequently placed in another genus, variously designated by the above names? As Weinland named this genus *Schistosoma* in 1858, and Cobbold named it *Bilharzia* in 1859 (both names complying with the conditions of Article 25), the latter must be rejected under the Law of Priority, and the valid name of the parasite is accordingly *Schistosoma hæmatobium* (Bilharz, 1852). Of course, if it were desired to cite the genus only, this would be *Schistosoma* Weinland, 1858.

Article 26.—"The tenth edition of Linné's¹ 'Systema Naturæ' 1758, is the work which inaugurated the constant general application of the binary nomenclature in Zoology. The date, 1758, therefore is accepted as the starting point of Zoological nomenclature and of the Law of Priority."

Article 32.—"A generic or a specific name, once published, cannot be rejected, even by its author, because of inappropriateness."

This article prevents the alteration of a name based on some character supposed to be peculiar to the individual or group named, but which is subsequently shown not to be thus limited. The species *Necator americanus* Stiles, was so called from its supposed restriction to America. The validity of the name is not affected by the discovery that the species is widely distributed in the Old World.

Article 34.—"A generic name is to be rejected as a homonym² when it has previously been used for some other genus of animals."

¹ Linnæus.

² A homonym is one name for two or more things; a synonym more than one name for the same thing.

Owen in 1835 founded a genus *Trichina* for the parasitic worm which causes trichinosis. This name was rejected, as it had been applied to a genus of insects by Meigen in 1830. Subsequently Owen's genus was named *Trichinella*.

Article 35.—"A specific name is to be rejected as a homonym when it has previously been used for some other species of the same genus."

It will be noted from the preceding two articles that a generic name once promulgated is preoccupied as regards the whole animal kingdom, whereas a specific name is preoccupied only so far as its own genus is concerned. The zoological name of the parasite of quartan malaria is *Plasmodium malariae*. Now Grassi and Feletti, who described the parasite of malignant malaria at a later date, placed it in a different genus under the name *Laverania malariae*. Some protozoologists hold that the characters of the malignant parasite are not sufficiently differentiated to justify its inclusion in another genus (*Laverania*). If this view obtains, the parasite must be allocated to the genus *Plasmodium* where its specific term cannot be *malariae* as this is preoccupied for the quartan parasite. Therefore the malignant parasite assumes the name, *P. falciparum*.

Two other articles, though less important than the foregoing, are of sufficient interest to be mentioned.

Article 14, Section C.—"If the name is a modern patronymic the genitive is always formed by adding to the exact and complete name an *i* if the person is a man, or an *ae* if the person is a woman."

Article 19.—"The original orthography of a name is to be preserved unless an error of transcription, a *lapsus calami*, or a typographical error is evident."

The interpretation of these two Articles has led to difference of opinion regarding the correct termination of personal specific names, e.g., *Anopheles rossii*, or *A. rossi*. At first glance it might appear obvious that "*rossii*" was not permissible under Article 14, but the author of the name cited evidently considered that, an English, or rather a Celtic, patronymic should itself be Latinized before receiving the addition of a Latin ending. This would give "*Rossius*" of which *Rossii* would be the genitive. A case of this nature was submitted to the Commission for a ruling, and they took the view of the question given above. Their finding is set out in Opinion 8, where they advise that names having the double *i* originally should remain unchanged, but that new formations should have only the single vowel added to the *exact* name. As the species taken as an example was named *rossii* by its author in 1899, and Opinion 8 was not published until 1910, the original form of the name is correct.

It will be apparent from the examples quoted that the validity of a specific name is unaltered by any fate which may befall the genus to which it was first assigned. This original genus may be contracted or enlarged, or it may even disappear altogether if subsequent knowledge shows it was founded on false or insufficient characters. Unfortunately in the case of

some of the older species, there is difficulty in determining finally the correct specific name, for forgotten descriptions and designations may come to light and necessitate the abandonment of old and widely accepted terminology. The nomenclature of the yellow fever mosquito is a case in point and fills the uninitiated with bewilderment. Three generic terms—*Aedes*, *Aëdes* (*Stegomyia*), and *Stegomyia*—may be encountered, and any of these may be combined with one of three specific names—*fasciatus*, *calopus* and *argenteus*. First, as regards the generic term. To the earlier zoologists, the genus *Culex* was commensurate with the whole mosquito family, and consequently this insect first appears under this name. Though the domain of *Culex* was gradually encroached on by the establishment of other genera of mosquitoes, the species under discussion was not removed until Theobald founded his genus *Stegomyia* in 1901, the chief characters for this being the flat scales on the head and scutellum. Many of Theobald's proposed genera have fallen under the blows and buffets of later workers, and most authorities now hold that *Stegomyia* also is not sufficiently demarcated to retain generic rank, but should be merged in the reconstructed genus, *Aedes*. Some discard the term *Stegomyia* entirely, while others retain it, enlarged from Theobald's original idea, to label one of a number of natural groups or subgenera into which *Aedes* can be divided. Consequently the generic conception which includes this species can be expressed as *Aedes*, *Aëdes* (*Stegomyia*), or *Stegomyia*, according to the view adopted by the user.

Next as regards the specific terms. Until recently the earliest known names for this mosquito were *Culex fasciatus* Fabricius, 1805, and *Culex calopus* Meigen, 1818. The former of these was accepted as the valid name and its adoption by Theobald in the form of *Stegomyia fasciata* familiarized it to all. Objection was made, however, that the name *fasciatus* had been preoccupied and so was not available when Fabricius adopted it, and consequently the yellow fever mosquito ought to be called *calopus*, the next name in sequence. A number of people accepted this view and *calopus* is often seen, especially in American literature. Now the mosquito named *fasciatus* by Müller in 1764 has been doubtfully identified as *Culex pipiens* Linnæus, and if the identification is correct, this species having been named *pipiens* by Linnæus in 1758 could not be called *fasciatus* by Müller in 1764; therefore the latter name was unoccupied and available for Fabricius. On the other hand, if Müller's *fasciatus* cannot be identified, the validity of Fabricius' name is unaffected, for a name must be attached to some entity and not to an intellectual abstraction, so that so far as this objection is concerned, the yellow fever mosquito is correctly called *fasciatus*. Recently, however, a description has been discovered of a mosquito named *Culex argenteus* by the Abbé Poirét in 1787. As the identification of this species is of great importance I have abstracted his description from the original publication.

"*Culex argenteus*, dorsum squamis argenteis exornatum, pedibus

fasciatis." After a few words concerning the fate of his specimens, he continues: "*C'est le cousin le plus commun en Barbarie. Il est de la grosseur du nôtre mais si richment paré que je lui ai souvent pardonné ses piquûres pour le plaisir de l'admirer. Tout son corps, particulièrement le dos, est couvert d'écaïlles argentées, placées sur lui comme autant de paillettes orbiculaires et brillantes. Ses pattes sont ornées de bandes alternatives brunes et argentées.*"

("Culex argenteus, the back ornamented with silver scales, feet banded. . . . This is the most common gnat in Barbary. It is of the size of our own, but so richly adorned that I have often forgiven its bites for the pleasure of admiring it. All its body, particularly the back, is covered with silver scales placed on it like so many orbicular and brilliant spangles. Its feet are ornamented with bands alternately brown and silver.")

If this description, obviously very imperfect, is considered in its entirety there can be no doubt that the Abbé was dealing with "*S. fasciata.*" *C. argenteus* was clearly a brightly marked mosquito, and the commonest in Barbary. *A. (S.) vittatus* (Bigot) is excluded by the description, besides which it has been reported from the Palæarctic region apparently on one occasion only, and then in Corsica. Only two specimens of *A. (S.) cretinus* Edwards are recorded by its describer, both from Crete, and Mr. Edwards tells me that neither of these species has ever been reported from "Barbary." Consequently if Poirét's remark on the distribution of his mosquito is admitted as part of his description—and I know of nothing in the Rules to exclude it—by the Law of Priority the name *fasciatus* should lapse and be replaced by *argenteus*. Some may object that remarks on distribution and habits are inadmissible as a definition of a species. If this be so, then many of our oldest and universally accepted zoological names ought to disappear. It would be impossible to determine the species named *Pediculus humanus* and *Musca domestica*, for example, without the remarks about their respective distribution — "*Habitat in capite et vestimentis humanis,*" and "*Habitat in Europae domibus.*"

Poirét's description is very incomplete, according to our ideas, but so far as it goes it is correct, whereas Fabricius in describing his *Culex fasciatus*, commits a grave error. He says, "*Caput nigrum, haustello porrecto fasciis tribus niveis*" ("Head black, with extended proboscis with three snow white bands"). It is evident that Fabricius was dealing with a damaged male, and mistook a palp for the proboscis, but his description, taken literally, could not apply to any known mosquito. I cannot see how any one could be so precise as to strain out* Poirét's gnat, and yet swallow the camel of Fabricius' triple banded proboscis. It is a pity if an old established name like *fasciatus* should have to disappear, but at present I do not see how the Abbé Poirét's specific term can be rejected, much as we should all like to see the well known *fasciatus* retained; and unfortunately, it will be long before *Aedes (Stegomyia) argenteus* becomes a household word like *Stegomyia fasciata*. Poirét's name has been accepted by

Edwards, of the British Museum, and other authorities, though there will doubtless be bitter exchange of apostolic blows and knocks before a final agreement is reached.

In cases like the foregoing, the application of the rules of nomenclature may cause inconvenience, but the more rigidly they are enforced the sooner the day will dawn when the happy student has to memorize only one name for each species. As long as the principles of nomenclature remain a mystery to us, names are necessarily employed in a haphazard and unreasoning fashion, for the selection of the term chosen cannot be justified, nor its form comprehended; and being blind ourselves, we cannot discern if those guides whom we helplessly follow are themselves gifted with vision.

* ("Strain at a gnat" in the Authorized Version of the Bible (1611) is a misreading for "strain out." The Vulgate (384) has "*excolantes culicem*," which Wyclif (1389) renders by "clensynge a gnatte," and Tyndale (1526) by "strayne out a gnat." The Old English "Gospels" (995), translated not from the Vulgate, but from a still earlier Latin text, have "ge drehnigeath thone gnæt áweg," i.e., "Ye drain the gnat away." The Revised Version (1881) restores Tyndale's rendering of the passage.)

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Editorial.

SHELL-SHOCK.

PRIOR to 1914 the attention of R.A.M.C. officers so far as preventive medicine was concerned was chiefly directed to the infectious diseases. The late war, while vindicating the wisdom of the preventive measures adopted, has shown that there are other as important causes of wastage. For instance, minor septic complaints and such ill-defined conditions as myalgia accounted for a large percentage of the ineffectives.

Functional nervous disorders too, became increasingly prevalent as the war went on. The obscure nature of these conditions and the dramatic symptoms such as mutism and loss of memory displayed by the sufferers aroused much popular interest and sympathy, and the common belief that the sufferers were the victims of an injury to the brain caused by shells bursting in close proximity added thereto. This interest culminated in a Parliamentary demand for an inquiry into the origin and nature of the disabilities which had been labelled "shell-shock." A War Office committee of inquiry presided over by the Right Honourable Lord Southborough, G.C.B., G.C.M.G., G.C.V.O., K.C.S.I., was appointed in August, 1920. It has recently completed its inquiry and has presented a report which has now been published.¹

The items of reference to the Committee covered a wide field. They were as follows:—

"To consider the different types of hysteria and traumatic neuroses, commonly called shell-shock, to collate the expert knowledge derived by the Service Medical Authorities and the medical profession from the experience of the war, with a view to recording for future use the ascertained facts as to its origin, nature and remedial treatment, and to advise whether by military training or education some scientific method of guarding against its occurrence can be devised."

The Committee heard a large number of witnesses representing opinions on the military, medical and legal aspects of the inquiry and were able from the evidence put before them to arrive at unanimity in their findings and their recommendations.

This evidence, considerable extracts from which appear in the report, expresses the opinion of both medical and combatant officers who served with the Forces, either in the front line or at the bases, in executive or administrative capacities.

It is demonstrated that the term "shell-shock" has proved a gross

¹ Cmd. 1734, pp. 215, H.M. Stationery Office, 1922.

and costly misnomer, and should be eliminated from medical nomenclature.

An extract will best show how the term arose. "It was born," as the report states, "from the necessity for finding at the moment some designation thought to be suitable for the number of cases of functional nervous incapacity which were continually occurring among the fighting units. Undoubtedly shell-shock signified in the popular mind that the patient had been exposed to, and had suffered from, the physical effects of the explosion of projectiles. Had this explanation of the various conditions held good, no fundamental fault could have been found with the term. But with the extension of voluntary enlistment, and afterwards the introduction of conscription it was discovered that nervous disorders, neurosis and hysteria, which had appeared to a small degree in the Regular Army, were becoming astoundingly numerous from causes other than shock caused by the bursting of high explosives. It was observed in fact that these conditions were perpetually occurring, although the patient had not suffered from commotional disturbance of the nervous system caused by bursting shells. It even became apparent that numerous cases of shell-shock were coming under the notice of the medical authorities where the evidence indicated that the patient had not even been within hearing of a shell burst. On the other hand it became abundantly plain to the medical profession that in very many cases the change from civil life brought about by enlistment and physical training was sufficient to cause neurasthenic and hysterical symptoms, and that the wear and tear of a prolonged campaign of trench warfare with its terrible hardships and anxieties, and of attack and perhaps repulse, produced a condition of mind and body properly falling under the term 'war neurosis' practically indistinguishable from the forms of neurosis. . . . Once their nature had been determined it was possible for the medical man who was previously familiar with the handling of cases of nervous and mental diseases to place each case under its proper caption. But only a comparatively few medical men prior to the war had had an opportunity of becoming thoroughly familiar with this very distinct branch of medicine, and it frequently occurred that a medical officer who was not so happily placed, found himself in the position of having to deal with large numbers of such cases. Under the circumstances, therefore, with the official adoption of 'shell-shock' as a technical term, with the feeling of not being justified in making a more definite diagnosis, with the desire to avoid the stigma to the patient of describing his condition as a mental disorder, the medical officer preferred, or was driven, to include any particular case under the more general but less implicating heading of 'shell-shock.'"

The cases which were grouped under this loose term "shell-shock" divided themselves into three main classes:—

(1) Genuine concussion without visible wound as a result of shell explosion. These cases were relatively few.

(2) Emotional shock, either acute in men with a neuropathic predisposition, or developing slowly as a result of prolonged strain and terrifying experiences, the final breakdown being brought about by some relatively trivial cause.

(3) Nervous and mental exhaustion the result of prolonged strain and hardship.

In many cases the three factors of commotional and emotional shock and exhaustion were combined in varying proportions.

The report confirms the conclusion which had already been generally accepted by the medical profession, that the war produced no new nervous disorders, but simply aggravated and coloured forms already recognized in civil life.

The Committee inquired into these disorders under the headings :—

(1) (a) Commotional disturbance; (b) and/ or emotional disturbance.

(2) Mental disorders.

They chose the term commotional shock rather than concussion, since the evidence given showed that commotion or concussion of the central nervous system might be brought about either by direct aerial percussion and repercussion in closed spaces or that the man might by the aerial compression be blown along a road or into the air, or might be struck by sandbags or collapsing dug-outs, etc. In many cases it is impossible to decide whether the case is one of concussion by forcible contact with solid substances or one of commotion due solely to aerial percussion transmitted through the skull and spine to the cerebro-spinal fluid.

It is the commotion to the brain, whether there has or has not been concussion, which causes the symptoms, and therefore the Committee adopted this term for the cases which were labelled "shell-shock without visible wound."

They held the opinion, however, that in fatal cases of genuine concussion, gross and naked-eye hæmorrhages would most likely be found post mortem. In commotion cases, on the other hand, the hæmorrhages are microscopic, resulting from the rupture of small vessels in the substance of the brain. They explain the presence of blood in the cerebro-spinal fluid which was found during life when lumbar puncture was performed soon after the injury. Attention is drawn to the fact that similar minute hæmorrhages are found in cases of carbon monoxide poisoning, and in the opinion of the Committee a number of the cases reported as "death from shell-shock without visible wound" may in reality have died from carbon monoxide poisoning.

So prevalent did shell-shock become during the war and so difficult was the diagnosis between emotional and commotional shock, that many and detailed instructions were issued as to diagnosis, and an Army Form—W.3436—was introduced for the purpose of obtaining evidence from reliable sources as to the patient's proximity to a shell burst. In practice this form failed to attain its object in numerous cases. Medical officers should

therefore study those sections of the Report which deal with the distinguishing features of commotional and emotional shock and shell-shock wound.

In the early stages the two conditions can rarely be mistaken by the trained observer, but in the later stages symptoms may readily be misinterpreted.

Important distinguishing points are as follows :—

In true commotion or concussion there is complete loss of memory of the causal accident. It is not possible to recover this memory by any therapeutic measure.

Evidence of direct injury such as ruptured tympanum (if there has been no pre-existing ear disease), contusion epistaxis, and, more rarely, signs of organic injury to the central nervous system, will aid in the diagnosis.

In concussion as opposed to neurosis of emotional origin, there is complete absence of emotional instability.

Whether or not shell-shock should be classified as a battle casualty led to much discussion during the war. The sufferings of the patients were very real, in numerous instances the disabilities sustained were as serious as those from gunshot wounds. On the other hand, it was held by certain observers that no patient who failed to show visible signs of external wounds should be classified as a battle casualty. Though it was recognised that such a rule would inflict hardship on individuals it was felt to be a wise one from the point of view of maintaining morale in fighting troops.

In view of the evidence submitted and the uncertainty and complications attending the mode of origin of the neuroses of war, the Committee state definitely their recommendations as to inclusion of such patients amongst battle casualties.

They consider that concussion or commotion attended by loss of consciousness and evidence of organic lesion of the central nervous system should be regarded as a battle casualty. That no case of psycho-neurosis or mental breakdown, even when attributable to a shell explosion, should be so regarded, and that doubtful cases should be decided by a board of experts after observation of the patient in a neurological hospital.

These recommendations if accepted should considerably lighten the task of the Executive Medical Officer in the future in dealing with such cases.

How the term shell-shock arose has already been explained: a section of the Report deals with the causation of the conditions grouped under this designation.

The most potent cause of all is the emotional effect produced by the bursting of high explosives acting as an immediate agent with the stress of battle or severe mental stress of any kind acting as the accompanying latent factor.

In the majority of cases of war neurosis it is agreed that there already existed a congenital or acquired predisposition to pathological reaction, and that this constitutional characteristic was of vast importance. Acute illnesses such as malaria and dysentery acted as predisposing causes.

At the same time it appears certain that under the conditions of modern warfare, any individual, even if of sound nervous-physical constitution, may break down on the nervous side.

Responsibility, especially in those ill adapted to bear it, acted as a contributory cause of breakdown.

Other contributory causes were inaction under fire, exhaustion, fatigue, sleeplessness, warfare gases, alcohol, syphilis, and the acute infectious diseases.

Alcohol did not appear to be a potent cause in the British Army. In a series of 100 cases of shell-shock and 100 cases of wounds under his care, Sir Frederick Mott found that the use and abuse of alcohol were less common among the shell-shocked than among the wounded.

Treatment of war neurosis in forward areas and at the base is discussed at length in the report, and the conclusions of the Committee may be summarised as follows :—

No soldier should be allowed to think that loss of nervous or mental control provides an honourable avenue of escape from the battlefield. Slight cases should be kept in battalion or divisional areas when the only treatment necessary is rest, comfort and heartening for return to the front.

More serious cases require treatment by experts in nervous disorders in special centres which should be as near the front as possible.

When evacuation to the base is necessary, treatment should be conducted apart from the ordinary sick and wounded. Invaliding to the United Kingdom should be exceptional.

An atmosphere of cure is the essential of treatment, and the personality of the physician is all-important.

Though the hypnoidal state and deep hypnotic sleep have their uses, in the majority of cases the simplest forms of psychotherapy—explanation, persuasion, and suggestion—give the best results. Freudian psycho-analysis is not recommended.

It will be seen from the above that the Committee were impressed by the necessity for a clear and definite policy in dealing with these disorders, since the evidence before them showed clearly that not only might neuroses become contagious in a unit, and therefore prove a cause of serious wastage, but that injudicious treatment might do serious damage to the patients themselves since they are in a very suggestible state.

The conclusions of the Committee on the question of cowardice in relation to shell-shock are of interest to those medical officers who have been called upon to give evidence as to the mental and nervous condition of men accused of such serious crimes as cowardice and desertion in the face of the enemy.

It is recognized that the military view of cowardice is justified. No army could accept the proposition that cowardice in the face of the enemy should be looked upon as nothing but a nervous disorder. But fear is the chief factor both in cowardice and emotional shock. Fear is an emotion

common to all, but if a man fails to exercise self-control when capable of doing so, he is a coward. The Committee frankly admitted that it is just here that the difficulty lies, i.e., in deciding whether a man is or is not guilty of cowardice. But in each case the question must be answered: has or has not the individual crossed the border-line which divides normal emotional reaction from neurosis with impairment of volitional control? In cases when there is any reasonable doubt of the individual's power of control, experienced medical opinion should be sought, and the man's whole personal and family history, so far as it is obtainable, should be reviewed in coming to a decision.

Though the report contains much valuable information regarding the treatment of cases of war neurosis, perhaps the sections most interesting to the Army medical officers are those dealing with prevention.

How far is it possible in the examination of recruits to exclude men liable to neuroses, and when admitted to the Services to prevent them suffering therefrom under the conditions of modern war?

In dealing with recruiting, the Committee extended their inquiry into an examination of the pre-war standards of fitness and the methods of medical examination of recruits before and during the war.

The report itself and the evidence quoted show how complete was the breakdown of the pre-war system when faced with the enormous numbers of recruits who came forward in 1914—a breakdown accentuated by the withdrawal of the trained recruiting staffs on mobilization.

Although the instructions contained in A.M.S. Regulations referred briefly to examination for mental and nervous stability, it is evident that insufficient attention was paid to this part of the medical examination until well on in 1916.

Instructions issued by the War Office on the subject failed to reach those most concerned. As a result, numbers of men quite unfitted to withstand the strain of war were admitted to the Service, and many of these broke down without even going overseas.

The Committee conclude that every endeavour should be made at the time of enlistment to ascertain the nervous and mental condition of the candidates both from their previous histories and present condition. They recommend that the following should be included as instructions to medical officers engaged in recruiting duties:—

(1) "Where a candidate for entry into any of His Majesty's Naval or Military or Air Force Services is required to certify in writing that he has not to the best of his belief suffered from certain specific conditions, 'insanity' and 'nervous breakdown' shall be included.

(2) "Where a candidate is called upon to reply verbally to questions as to his previous health, 'insanity' and 'nervous breakdown' shall be included in the questions.

(3) "A proved history of insanity or epilepsy shall entail rejection.

(4) "The following directions be included in instructions issued to

medical officers who are employed in the examination of candidates for His Majesty's Naval, Military, and Air Force Services: 'In examining a candidate the medical officer will observe the demeanour of the candidate and the degree of intelligence with which he responds to questions and directions.' 'He will ask him a few simple questions about his childhood, family, occupations, etc., and from the replies should be able to form an estimate of the mental capacity, power of attention, memory, emotivity, and general mental calibre of the candidate.'"

"Further information may be gained by observing the facial expression and conformation of the skull, nose, jaws, palate, and pinna (hydrocephalus, microcephalus, evidence of injury or other physical stigmata, may be noted). Every examination will include Romberg's test, observation of the pupils as to regularity of outline, size and equality, reaction to light. The patellar reflexes will be tested—others if necessary. The presence of tachycardia, tremor or sweating, if persistent, constitutes a serious disability. Candidates who present well-marked signs of nervous instability or serious mental defect should be rejected. In estimating the degree of mental or nervous instability presented by a candidate, the medical officer will consider to what extent the condition is likely to be a bar to effective military service, rejecting the unfit, obtaining a colleague's or specialist's opinion in dubious cases, and recommending special observation during training for those whom he accepts in spite of a minor degree of mental or nervous defect.

"A note will be made on the mental and nervous stability of each candidate on the Medical History Sheet."

It is recommended that in order to provide for the expansion of recruiting on mobilization, not only all regular R.A.M.C. officers, but also all those of the Special Reserve and Territorial Force should undergo a prescribed course of instruction in the methods of examination of recruits and the physical and mental standard required.

Although such training may involve extra expense in peace time it would undoubtedly save enormous sums in war. The evidence quoted in the report shows that large numbers of men were passed into the Army by medical officers inexperienced in the examination of recruits; such men broke down under training, filled the hospitals at home, never did a day's soldiering with the forces overseas, and finally added to the pensions lists.

Again, the evidence quoted in the report shows that in 1914-15 the number of recruits examined by individual medical officers in a single day was such as to preclude anything beyond the most cursory examination for gross physical defects.

To safeguard against similar mistakes in future it is recommended that careful routine examination of each recruit should be insisted on, that medical history sheets be completed as in peace, and that returns be rendered daily as to the numbers examined by each medical officer, and

that observance of these instructions be ensured by frequent visits of an inspecting officer.

It is, however, to be remembered that on general mobilization the Deputy and Assistant Directors of Medical Services in Commands and Districts would be fully occupied with the provision of hospital accommodation, sanitation, and mobilization of units, etc. It is doubtful, also, whether the A.D's. and D.A.D.'s of Hygiene would be able to devote adequate time to such duties. If, therefore, this recommendation is accepted—and it would undoubtedly save much wastage after enlistment—it would appear to be necessary to detail selected officers for this work on mobilization.

The Committee further consider that as soon as possible after mobilization is ordered, individual recruiting medical officers should be superseded by boards, and that if compulsory military service is introduced the sectional method of examination and grading adopted by the Ministry of National Service should be introduced. It is emphasised that selection for particular arms of the Service is the function of posting boards and not of examining medical boards.

Even with such elaborate precautions it is impossible to make a full examination of the mental and nervous stability of candidates at the time of enlistment. Further observation should therefore be carried out during the recruit's training. This necessitates the closest co-operation between executive medical officers and commanding officers, instructors, and all those who are responsible for training.

Just as the medical officer watches over the recruit's physical development in the gymnasium, so he should study his mental development, paying attention to such things as petty military crime, slovenliness, unsociability in the barrack room, etc. In this way a further number of unstable individuals may be eliminated before joining their units.

The report deals with the prevention or lessening of the incidence of shell-shock under four headings:—

- (a) The time of enlistment.
- (b) The training period.
- (c) The active service period.
- (d) The hospital period.

The measures outlined above for ensuring adequate medical examination of candidates for enlistment cover the recommendation under (a).

As regards the remaining periods the essential measure is the inculcation of morale.

It is not considered that anything can usefully be done in training to produce the physical conditions of the front line or to give special instruction in shell-shock and how to resist it. The Committee content themselves with laying down the broad principle that training should aim at:—

- (a) The inculcating of the highest possible standard of morale, discipline, *esprit de corps*, esteem of officers, and confidence, both individually and collectively; and

(b) Ensuring and maintaining mental, physical and moral fitness and technical efficiency.

The length of training in the last war was inadequate owing to the incessant demand for men. The inevitable result was the high incidence of nervous disorders. Such incidence is lessened by prolonged and judicious training.

To carry out such training a high standard of efficiency is required in officers, and it is pointed out that all officers, both staff and executive, should be trained in a study of character so far as it is applicable to military life. Special instruction in the psychoses and psycho-neuroses as they occur in war should be given to R.A.M.C. officers, and selected officers should be encouraged to specialize in the study of these disorders.

In the active service period in addition to the maintenance of a high standard of morale the following are factors of importance in prevention or lessening the incidence of shell-shock: the careful selection of front line medical officers and close co-operation between them and the executive officers of units; short shifts of duty in the front line; adequate rest and organized recreation behind the line; the avoidance of monotony so far as possible by change of front, etc.; early diagnosis of incipient breakdown and treatment within divisional areas: retention of early cases in army areas: leave home if properly used: the controlled use of rum.

The employment of such terms as shell-shock, N.y.D., nervous D.A.H., or other designations which may become catchwords, is condemned, and emphasis is laid on the necessity for good sanitation and comfort in billets, rest camps, base depots, etc.

It will be seen that while none of the recommendations are of a revolutionary nature the report itself marks a new era in military medicine in that it points out that in modern war the mental and nervous stability of the soldier is as important as physical fitness. In the future, as pointed out by one witness, organization, training and administration should be based on a psychological foundation, if we are to teach troops to withstand the stress and horrors of modern warfare.

Clinical and other Notes.

NOTE ON STABILIZED BLEACHING POWDER FOR TROPICAL USE.

By F. S. AUMONIER, B.Sc., F.I.C., AND MAJOR S. ELLIOTT, O.B.E., B.Sc., F.I.C.

HITHERTO users of bleaching powder in the tropics have experienced great difficulty in obtaining samples of that substance in good condition owing to its decomposition by heat and moisture.

Experiments were carried out by Rettie, Smith and Ritchie, the results of which were published in the *Journal of the Society of Chemical Industry*, xxxvii, No. 23, 1918, pp. 311 T and 392 R. Under laboratory conditions mixtures of lime and bleaching powder were shown to possess a resistance to heat and moisture sufficient to withstand storage in a tropical climate.

This note shows the results of practical tests on a "lime-bleach" stored under ordinary conditions in various tropical countries.

(1) *Laboratory Experiments*.—It was found by experiment that an intimate mixture of twenty parts by weight of finely-powdered, freshly-burnt quicklime and eighty parts of the ordinary bleaching-powder as supplied to the Army, made a satisfactory mixture. The powder did not cake, lost practically no chlorine, and did not corrode the interior of a sealed tin when subjected to a moist heat of 50° C. for several weeks.

Experiments were also made to ascertain the effect of exposing the powder to air after the tin was opened, and the results were as follows: In the open tin in the laboratory at 60° F., the mixture lost 0.45 per cent of available chlorine in nine days.

A heap of powder exposed for three weeks in the laboratory lost 16.2 per cent of available chlorine on the outer layer, $\frac{1}{4}$ inch deep; the interior of the heap lost 1.6 per cent.

An opened tin in the incubator at 50° C. with the air saturated with moisture lost about 1 per cent of available chlorine in a week. The available chlorine in a control sample of ordinary bleaching powder, initially about 35 per cent, fell to 4.9 per cent under the same conditions.

(2) *Practical Tests*.—Samples of the 20 per cent lime mixture were made up in the laboratories of Messrs. The United Alkali Company and were sent to stations abroad in four-ounce tins with press-in lids and discs soldered hermetically over them, and also in four-ounce stoneware jars with ground lids sealed with paraffin wax.

The initial content of available chlorine before despatch was 25.2 per cent. The tins were stored under ordinary conditions, and fresh tins were opened on the spot from time to time and the contents examined. At the end of a year sample tins were sent home for examination and it was found that:—

- (a) The powder was in a good condition, dry and not caked.
- (b) There was no internal rusting or corrosion of the tins.
- (c) The available chlorine content varied from 23.6 to 24.8 per cent.

The results of tests on the spot were as follows :—

Date	Mesopotamia		Sierra Leone		Egypt		Egypt (stored in sun)	
Examined	Tins	Jars	Tins	Jars	Tins	Jars	Tins	Jars
July, 1921	25·0	24·6	—	—	24·5	25·3	—	—
October, 1921 ..	24·4	23·0	24·2	25·0	23·2	23·5	—	—
January, 1922 ..	—	—	23·4	24·0	23·6	23·5	23·4	23·5
February, 1922 ..	—	—	23·4	23·4	24·4	23·7	23·7	22·7
April, 1922	24·0	24·5	23·8	24·7	—	—	—	—

We have to express our thanks to those Royal Army Medical Corps officers who carried out these analyses abroad.

(3) *Manufacture*.—When ordinary bleaching powder is made, the water present during the reaction must always be slightly in excess of the quantity necessary for the hydration of the lime. When powdered quicklime is added to ordinary bleaching powder, this excess water slakes the added lime and heat is evolved. If hydration takes place gradually and the heat produced can escape quickly, the temperature does not rise to the decomposition point of the active chlorine compound. After the excess water has been taken up, and the heat thereby produced dissipated, the mixture is stable even in the tropics.

No difficulties were encountered in the preparation of the lime-bleach mixture on a laboratory scale, but on a large scale Messrs. The United Alkali Company found that the mixture tended to "fire" and rapidly to lose available chlorine. This difficulty was minimized by storage of the lime-bleach mixture at the works under carefully controlled temperature conditions until stable. Further experiments are being made to improve the method of reaching stability.

Conclusions.—Rettie, Smith and Ritchie's results have been confirmed by practical tests. The bleach stabilized with twenty per cent of quicklime will stand ordinary storage in tropical climates in four-ounce sealed tins, and after opening will not deteriorate to any appreciable extent in a few days.

Package in stoneware jars has no advantage over sealed tins.

As a result of these experiments, this stabilized bleach (twenty of quicklime and eighty of bleaching powder) has been adopted as a future service issue for water sterilization.

LECTURES AND DEMONSTRATIONS IN FIELD WORK ARRANGED
BY THE DIRECTOR OF MEDICAL SERVICES OF THE 15TH
FRENCH ARMY CORPS.

By MAJOR A. D. STIRLING, D.S.O.
Royal Army Medical Corps.

HAVING been nominated as a delegate to attend the French medical exercises, I proceeded to Marseilles in September to attend the course of lectures and demonstrations in field work arranged by Inspector General Bassères, Director of Medical Services of the 15th Army Corps. The course was arranged for the instruction of medical officers, pharmacists, dental surgeons, and administrative officers, and lasted three days. An invitation was extended to allied and neutral countries to send representatives, and the following attended :—

- (1) *Belgium*.—Dr. J. Voncken, Médecin Major 2ième Classe.
- (2) *Chili*.—Commandante Martinez, Chilian Military Attaché, Paris. Dr. Oscar Cifuentes S, Chilian Army Medical Service.
- (3) *Denmark*.—Dr. Marner, Médecin Major 2ième Classe.
- (4) *Italy*.—Dr. Giuseppe Villa Santa, Maggiore Medico, Professore Titoliere, Scuola Applicazione, Sanita Militare, Florence.
- (5) *Spain*.—Dr. Potous Martinez.

At the beginning of the course the foreign delegates and the French officers ordered to attend were received by Inspector General Bassères who extended a warm welcome. The reception was held in the lecture hall of the Grand Palais, forming part of the Colonial Exhibition which was held at Marseilles during the summer and proved a great success.

At 9 a.m. on Tuesday, September 12, the first of the series of lectures was given by General Bassères on "The Organization of the Medical Service in time of War." In a very able lecture he traced the organization of the Army as it was in 1914, and showed how poorly equipped the medical units were—the various changes and developments that took place during the course of the Great War were explained; and finally he gave a description of the general organization as at present contemplated.

The lecture will most likely be published in the journal of the French Medical Service, in which case a translation will be given in due course.

At 10.30 a.m. a visit was paid to the exercise ground where a demonstration was given of field units and technical apparatus of the medical service. A description of this will be given further on.

At 3 p.m. an interesting lecture was given by Médecin Chef de 2ième Classe de la Marine Brunet, on the subject of "Hospital ships, their installation, function and use." The hospital ships are controlled by the Navy. At the present time there are two, only one of which, however, is being utilized, and that for transport of invalids from Syria and Mediterranean ports. He considered a ship of some 8,000 tons the most suitable size—speed twelve knots—personnel, ten per cent of patients.

At 5.40 p.m. a further demonstration of field units and equipment was given. Next day a most able and instructive lecture was given by Médecin Principal

de 1re Classe Rouvillois, Professor at Val de Grâce, on the subject of "New Apparatus used by the Medical Service in the Treatment of Fractures."

He explained the necessities from the point of view, (a) of transport and (b) of treatment.

He paid a tribute to the work of Sir Robert Jones and of Major M. Sinclair, R.A.M.C., to the former for his efforts in securing the adoption of Thomas's splint, which led to a great reduction in the mortality rate in cases of fractured femur due to gunshot wound, and to the latter for his work in the treatment of fractures by the special apparatus of his design. Professor Rouvillois explained that the subject of his lecture referred to new apparatus, but that in reality he was dealing with up-to-date patterns of old designs.

He laid emphasis on the necessity for having standard splints—simple in design, easy of application, and of proved efficiency, with the additional merit of being readily bundled for storage and transport.

Amongst others he explained and demonstrated the Lardenois modification of Thomas's splint which had been adopted in the French Army (fig. 1).

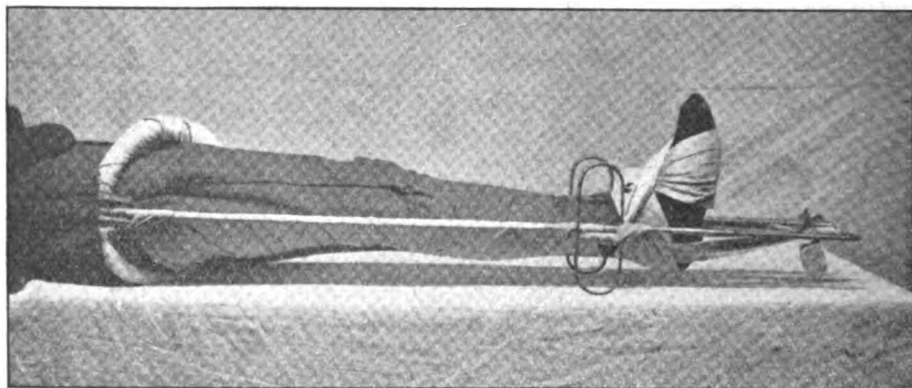


FIG. 1.

The chief modifications are : (a) The ring is in two parts which are hinged, allowing of easy application, and no leather is used on account of the liability to perish in store ; (b) supporting wings are fitted to the splint to keep the limb raised from the bed or stretcher.

The splints can be readily packed in bundles.

After the lecture a further demonstration of field units and apparatus was given.

In the afternoon an instructive lecture on the subject of " Water in the Field and its Purification " was given by Pharmacien Principal de 1re Classe Nanta, and thereafter a visit was paid to the General Stores Depot and the Depot of Medical Stores—Le Magasin Général et la Pharmacie Générale d'approvisionnement du Service de Santé. This depot has been constructed since the war, and when complete will form the principal depot of the French Army.

The depot, situated on the outskirts of Marseilles, consists of well-designed modern buildings, with a special railway line running through. In the depot are

stocks of every kind of vehicle, motor ambulance wagons, portable disinfectors water sterilizers, etc., used by the medical service, in addition to ordnance and medical and surgical stores. It will be seen that this system is quite different from that pertaining in our Army, and the arrangement, no doubt, has certain advantages, although during the late war there was no cause for complaint regarding the supply of ordnance and other stores. The general arrangements were fully explained by General Bassères and by Colonel Nanta, and it was most interesting to see how the requirements of a large army under conscription are met.

Next day an instructive lecture was given by l'Officier d'Administration Principal Vincent on the subject of "Administration, and the functions of an administrative officer in the various formations of the medical service in war." Administrative officers carry out all duties in connexion with pay, allowances, payment for stores, etc., combining the functions of a quartermaster and, to a certain extent, those of field cashier. The officer commanding a medical unit is thus relieved and can devote his whole time to the welfare of the patients under his charge.

After the lecture a demonstration of a hydroplane fitted to carry two stretcher cases was given.

The method of loading and unloading was demonstrated, but on account of the rough weather prevailing a flight was not attempted. The patients are accommodated in the body of the machine behind the pilot, the stretchers being suspended one above the other.

The hydroplane was for general use and not specially adapted for the medical service.

In the afternoon an interesting and instructive lecture was given by M. le Médecin-Inspecteur Thiroux on the subject of "The Prevention of Intestinal Infectious Disease amongst Troops in the Field." He dealt with all the bacterial diseases and intestinal parasites that are likely to be met with in tropical and sub-tropical countries.

A short description of the field units and medical equipment demonstrated will now be given.

These were displayed in a convenient manœuvre field on the outskirts of Marseilles. In addition to the field equipment, a most interesting collection of specimens from the famous museum and hospital of Val de Grâce was exhibited in huts at the entrance to the field. This included the following:—

(1) Specimens of all the vaccines and sera in use in the French Army, which are prepared at Val de Grâce, together with pamphlets describing exactly the method of administration, and also a collection of excellent photographs showing the various processes of preparation.

(2) A complete collection of gas masks, showing the development from the earliest to the latest type—both French and foreign.

(3) A collection of steel helmets, showing the effects of rifle-bullets, shrapnel, etc., and demonstrating clearly the amount of protection afforded.

(4) A collection representative of the drugs and dressings, etc., prepared in the French Army.

(5) An interesting series of photos of the Hospital of Val de Grâce.

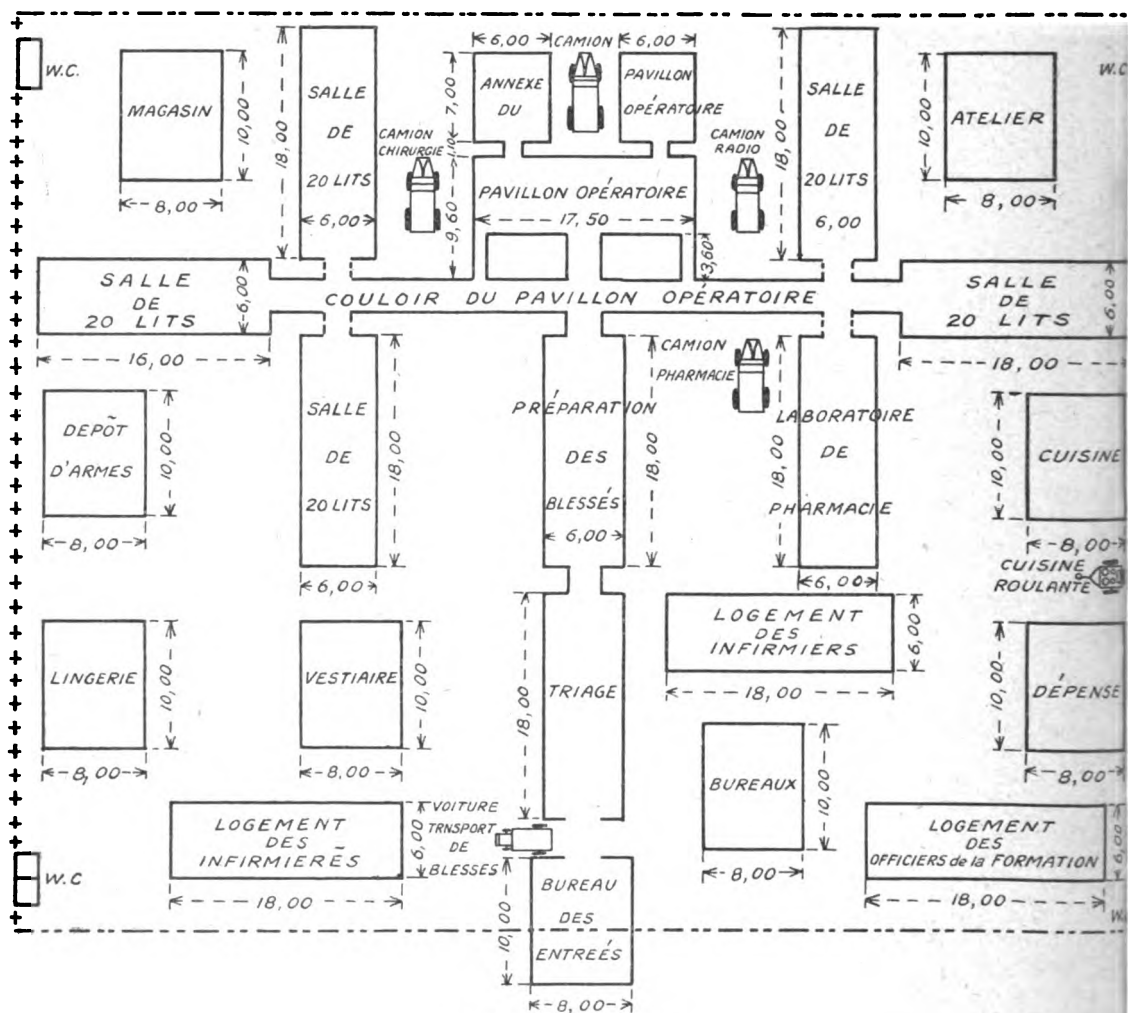
(6) A collection of surgical instruments, operating gowns, splints in use.

The Field Units demonstrated were as follows :—

(1) *Ambulance Chirurgicale*.—Light field hospital for surgical cases. This consists of :—

(1) Reception room.

(2) Sorting ward, where cases of various types are sorted out prior to operation and transfer to the special ward.



Ambulance Chirurgicale.

(3) Preparation ward.

(4) Operation theatre with mobile X-ray unit. Surgical wagon and sterilizing wagon attached.

(5) Five wards of twenty beds each.

(6) The usual administrative offices and stores.

- (7) Travelling kitchen in addition to the usual kitchen.
- (8) Laboratory and pharmacy.
- (9) Workshop.

A plan of this unit is shown.

(2) *Ambulance Médicale*.—Field hospital for medical cases with special arrangements for dealing with mustard gas cases.

To this is attached a section for corporal hygiene, barber's shop, etc.

For dealing with gas cases one marquee is equipped with spray baths and complete arrangements for bathing of these cases.

Another ward is equipped with a special apparatus, "Bossy," for the economical and continuous administration of oxygen.

The "Bossy" apparatus consists of an ingenious device for attachment to an oxygen cylinder, which can be easily attended to by an orderly. The device consists of a manometer which maintains a certain level when the requisite amount of oxygen is being consumed.

The apparatus connects with a rubber, or preferably, metal, distributing tube (the latter is easily supported on the bed rail). From this tube are rubber leads connected with a suitable inhaler at each bed. The inhaler has a valve which shows at once whether the patient is taking oxygen or not. If an extra patient is put on oxygen the "Bossy" indicator drops at once and more oxygen must be allowed. Similarly, if a patient is taken off oxygen the float rises and the orderly should at once reduce the supply of oxygen.

Other exhibits included :—

(1) Medical and surgical equipment of an "*ambulance*" designed for mountain warfare.

(2) A hangar with an aeroplane—type Bréguet-Limousine (with Renault engine 300 h.p.)—specially designed for the transport of patients. Two patients—stretcher cases—are accommodated in a comfortable cabin with space for an orderly. The pilot sits behind the special cabin which is in full view.

(3) A hangar designed for the medical service, thirty-two by sixteen metres containing :—

- (a) Various types of stretchers—wheeled, etc.
- (b) Dental cabinet.
- (c) Dental unit.

(d) Field laundry and drying room carried on two horse-drawn wagons. This consists of up-to-date laundry plant and is capable of washing thirty to forty kilograms of linen per hour.

(4) In another hangar the following were displayed :—

- (a) Apparatus for disinfection, disinsectisation, and provision of shower-baths, mounted on a horse-drawn wagon.
- (b) Water sterilizer.
- (c) Clayton disinfection apparatus.
- (d) Various disinfectors.

Descriptive pamphlets with photographs of each type of apparatus were issued as well as various leaflets describing the method of use of various vaccines, and charts showing the incidence and mortality from typhoid fever and dysentery, which were of great interest. As the result of inoculation the mortality from typhoid fever in the French Army fell from 118 per 100,000 in December, 1914, to

0.6 per 100,000 in January, 1917, about which level it remained till the end of the war.

At the conclusion of the demonstrations, General Bassères explained that he considered this course of instruction as being of much more use and much less costly than ordinary manœuvres in which only a small proportion of those attending could see each type of formation and the various specimens of apparatus.

THREE UNUSUAL CASES IN ONE MONTH.

BY MAJOR J. T. D. DOUGLAS.

Royal Army Medical Corps.

ONE often hears both outside and inside the Service that army doctors see and get no experience in unusual and rare cases, and that their cases are confined to a stereotyped and limited class.

During one month at this small hospital and station the following cases occurred :—

(1) *Henoch's Purpura*.—A young girl of 15, daughter of Serjeant L., subject to a rheumatic tendency, reported sick with pains in her limbs, and a petechial rash. Several years ago she had a severe attack of diphtheria and was treated with antitoxin. She also suffered from rheumatic pains and stiffness for the last few years, so that the rash was at first thought to be one of peliosis rheumatica. However, in a few days she developed slight temperature with acute abdominal pains and hæmorrhage from the bowel. She was immediately put on a course of calcium chloride and a mixture of iron and arsenic to combat the anæmia, which was severe.

She eventually made a good recovery, except for a slight relapse.

(2) *Landry's Paralysis*.—A married serjeant of one of the depots reported sick in his quarters with tingling in tips of toes and fingers. He had recently returned from an educational course in the south of England, where he had evidently worked very hard, and taken very little exercise. He was a man of poor physique and rather neurasthenic.

On the third day of his treatment in quarters he was transferred to hospital. There was no other history except that the day before he went sick he had lost control over the finer movements of his fingers, and dropped the chalk while writing at the blackboard in the school.

On examination there was paresis of both legs, as also slight paresis of both arms. Reflexes were absent, thermal and tactile sensations diminished and delayed. Complained also of a drawing pain between the shoulders. Wassermann negative.

On the third morning in hospital I noticed fibrillary twitchings of a muscle in his hand, and also a slight slurring of his speech, and came to the conclusion he was suffering from an acute ascending paralysis with "bulbar paralysis."

He had not lost control over bladder and rectum.

He was transferred the same afternoon to the local civil hospital for nursing, but at 8 p.m. the same day he died.

The post-mortem showed general acute toxic change in the spinal cord with

an encephalitis. No cause was found, but owing to the recent epidemic of influenza the influenza bacillus may have been the agent.

(3) *Cerebral Tumour*.—Serjeant P., who had had long service in India, was admitted to hospital on May 15, 1922. There was no history of previous illness except frequent attacks of malaria while in India.

His only symptoms were intense frontal headaches at intervals. Wassermann negative. The day before his transfer to York he developed cerebral symptoms, i.e., incoherent muttering about his life in India, and some ataxia, but in the intervals he was quite rational.

He died on June 5, at York, from a cerebral tumour which, I believe, is being reported in the Journal in detail.

• Current Literature.

Bulletin de l'Institut Pasteur Revue, No. 13, July 15, 1922.

General Immunity by Local Immunization. By A. BESREDKA.

(a) Dysentery Bacillus.

The mechanism of the infection and of the defence in regard to the rabbit. Intestinal infection and intestinal immunity.

The problem of vaccination is, as has been shown, simple in the case of bacilli such as anthrax in which case it is necessary to immunize the skin; it is not so simple in the case of dysentery, typhoid and paratyphoid which show, in appearance at least, an equal virulence for all organs.

Laboratory animals can be killed by injection of these bacilli by a variety of routes.

It is usual to vaccinate against these bacilli by the subcutaneous route.

The buccal route of vaccination has been tried from time to time but with little success in the laboratory animals. It is nevertheless the buccal route which will be shown to be the most efficacious against the bacilli in question.

It is well known that when rabbits are injected with fatal doses of dysentery bacilli the organ most readily attacked, if not the only one, is the intestine.

In natural conditions in infection by dysentery, cholera and typhoid the port of entry is the mouth.

Animals are more protected against infection by this route than is man. It is difficult to infect rabbits or guinea-pigs by this route.

But if infection is made by the peritoneal route or by the blood stream it is the intestine which is attacked and suffers; the intestine is therefore the susceptible organ.

As regards dysentery specially, if a suitable dose is given in the ear vein of a rabbit it dies in twenty-four to forty-eight hours.

If examined soon after death, the blood, the urine and the organs are all sterile but the intestine from the gall bladder to the cæcum swarms with *Bacillus shiga*. They are so numerous that they replace the normal inhabitants of the intestine—*B. shiga* reigns alone.

The bacillus is not spread through the body but is found only here; there is a strong attraction for them in the intestinal mucous membrane.

The same thing occurs if the bacilli are introduced by the peritoneal route or by the subcutaneous; they do not remain in the tissues or peritoneal cavity—they pass to the intestine where they multiply rapidly.

The intestine is to the *B. shiga* what the skin is to the anthrax bacillus.

We should be guided by this in the choice of a means of immunization; as the intestine is the susceptible organ it is necessary therefore to vaccinate locally.

B. shiga, which is lysed, readily sets free an endotoxin which acts on the tissues in general.

The injection of a heavy dose of a culture of *B. shiga* even if killed gives rise to grave damage of the small intestine and may kill.

This is due to the power that the endotoxin has of stripping off the epithelium of the intestine and thus exposing the susceptible mucous membrane to the attack of the bacillus.

Mice and rabbits can be immunized against *B. shiga* by causing them to swallow in small quantities a vaccine of this bacillus.

The immunity resulting from such vaccination is of a high degree—they can resist a lethal dose of the bacillus whether it has been administered by the peritoneum, by the skin or vein.

The cells of the intestine are now immune and the immunity of the intestine suffices to protect the whole organism. This immunity takes place without the mobilization of antibodies in the blood—none can be demonstrated after immunization by the mouth.

In view of the above results the following experiment carried out by Ch. Nicolle is of interest.

(1) Two persons were vaccinated by the mouth by means of culture of *B. shiga* killed by heat—two non-immunized people were kept as control.

All four were caused to swallow a dose of living dysentery bacilli—the two non-immunized persons contracted the disease, the two vaccinated men remained fit and well.

(b) *B. typhosus* and *B. paratyphosus* and Cholera Vibrio.

Sensitizing by means of bile—mechanism of defence and of infection—entero infection and entero immunity.

Rabbits can support enormous doses of living cholera vibrios or *B. paratyphosus* B by the mouth, but if the intestinal epithelium is stripped off by means of a dose of ox bile given by the mouth, then the animal becomes at once susceptible—they develop diarrhœa, become wasted, and, if the bacillus is virulent, eventually die.

At the post-mortem the small intestine is seen to be congested, and almost transparent. It is filled with a liquid, in which float plaques of desquamated epithelium.

When the contents of the intestine are plated out the result is almost a pure culture of *B. paratyphosus*. Thanks to the desquamating action of the bile one is able to demonstrate the elective affinity of the virus for the intestinal wall.

The affinity of the typhoid paratyphoid group for the intestine is manifested just as clearly as is that of *B. shiga*. By whatever route the bacilli are injected they will be found in the intestine, and only there.

The same facts apply also to the cholera vibrio.

The mode of spread to, or rather their localization in, the intestinal apparatus is the same whether they are injected into the peritoneum, under the skin, or into the general circulation.

They behave as do the dysentery bacilli, as have already been described in detail.

It is obvious, then, that with regard to the *B. typhosus*, *B. paratyphosus* and cholera vibrio the susceptible organ is the small intestine, and our efforts at vaccination should be directed there alone.

As regards vaccination by the mouth with *B. shiga*, no preliminary sensitization is necessary—this is effected by the endotoxin; but as regards typhoid, it is necessary first, before the attempt to immunize by the mouth, to give a sensitizing dose of bile.

It has already been shown that to give rabbits large doses of killed cultures of

typhoid by the mouth, as one can readily do, does not immunize them against a lethal dose by the vein.

But if rabbits be first given a dose of bile, followed by a dose of killed culture by the mouth, absorption takes place and immunity is produced.

It is the same with regard to the cholera vibrio.

Animals which are given doses of killed cholera by the mouth after being sensitized by a dose of bile are found to be resistant to a lethal dose into a vein.

If the dose by the mouth is given without the bile no immunity is produced.

The explanation of this phenomenon is similar to that given for anthrax.

If anthrax is placed in the skin, or under the skin, no vaccination results, but if the bacteria are inserted *into* the skin, then immunity is produced. So with typhoid and cholera, if the mucous membrane is intact they will slip through the canal without invading the tissues, whereas when the mucous membrane is stripped of epithelium they pass into the tissues, affect the receptive cells and vaccinate.

As regards antibodies. These are not found in the case of anthrax, but can be demonstrated in the case of typhoid and cholera, but such antibodies are of a transient nature and soon disappear from the blood, although the immunity remains.

Just as in anthrax we have cuti-infection, cuti-vaccination, and cuti-immunity, so in typhoid and cholera we have entero-infection, entero-vaccination and entero-immunity.

Such local immunity results in immunity of the animal as a whole.

The bile might be compared to the scarifier in vaccination for smallpox.

Subcutaneous inoculation has been shown to be efficacious, but before the vaccine can reach the intestine, which is the organ it is necessary to vaccinate, a long path has to be traversed, and much is lost en route; for this reason intravenous inoculation would appear to be preferable to subcutaneous.

The most successful vaccines in treatment have been those associated with skin troubles such as staphylococcal and streptococcal—now these are known to produce but little or no antibodies in the serum; is it not then possible that this success is due not so much to production of antibodies in the blood, but to the vaccination into the skin or subcutaneous tissue producing a local immunity of the skin, which is the susceptible organ?

The New Chemical Therapeutic Agent "Bayer 205." (Summary prepared in the Medical Intelligence Section.) Ministry of Health. Med. 1. New Series No. 34. Memorandum circulated for the use of the Medical Staff.—During the last two years many workers in Germany have reported curative effects on trypanosomal infections in mice, rats, guinea-pigs, rabbits, dogs and horses with a new product made by the firm of Friedr. Bayer and Co., at Leverkusen, under the name "205." No description of the chemical composition and mode of preparation of the drug has been published, and according to MM. Brumpt and Lavier, who were recently given a small quantity for trial in France, all the information which the firm would communicate was that the preparation is free from arsenic and mercury. It is generally believed, however, that the drug is one of the derivatives of the series of dyes containing amino-naphthalene-sulphonic acid, and Dr. King, in the Annual Report for 1921, of the Society of Chemical Industry, has given a general account of its probable chemical relationship and formula. It is a white powder easily soluble in saline solution or distilled water, and can be sterilized without deterioration or change. In animal experiments it has been administered intravenously, intraperitoneally, subcutaneously, by intraspinal puncture, and by way of the alimentary canal without any local or constitutional ill effects. Two outstanding advantages claimed for

the drug are that in heavily infected animals, minute doses which are very much less than the toxic dose for the animal concerned produce a "sterilisatio magna," and that the drug has, for a considerable number of days, a prophylactic as well as a curative effect. On the first point Wenyon, experimenting on infected mice in England with a small quantity of the drug which had been presented to Sir David Bruce, found that the curative dose was not as high as $\frac{1}{40}$ th of the toxic dose; on the second point Haendel and Joetten, Brumpton and Lavier and others have reported failure to infect or re-infect treated animals within periods varying from three to twenty-four days after a curative dose.

Records of two human cases suffering from infections, one with *Trypanosoma gambiense*, the other with *T. rhodesiense*, have been published, the first by Muhlens and Menk, the second by the same workers and independently by Warrington Yorke. In the first case 0.25 gramme of the drug was given intravenously, and the same dose seven days later without an appreciable effect in freeing the blood from the parasites. Eleven injections of tartar emetic (total amount 1.06 gramme) were then given and the parasites disappeared temporarily from the blood. The patient then left the hospital and was lost sight of. The second patient was an Englishman infected in Rhodesia. Between October, 1920 and June, 1921, he was treated vigorously with many drugs including tartar emetic, antimony oxide, soamin, and stibenylin. During eight and a half months' treatment at the Liverpool School of Tropical Medicine he received intravenously 22.7 grammes of tartar emetic. There was temporary amelioration of symptoms, but the disease continued to relapse and it was decided to endeavour to get him treated with "205." This could only be done at Hamburg. He arrived there on July 3, 1921, seriously emaciated and anæmic. His spleen was enlarged and trypanosomes were present in his blood. The account by Muhlens and Menk, who carried out the treatment, states that he was given 0.5 gramme of "205" intravenously on July 9, followed at intervals of one, two, three or more days by doses of 1 gramme until a total of 6 grammes in all had been given. Fever disappeared six hours after the first injection and trypanosomes within sixteen hours. He quickly regained normal health, and Yorke's report states that up to November 11, when he was about to return to South Africa, complete recovery has been maintained.

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The Lighting of Hospitals. The *Illuminating Engineer*, Vol. XV., No. 6, 1922.—The June number of the *Illuminating Engineer* is devoted to a question which cannot fail to interest officers of the Corps, viz., "The Lighting of Hospitals." This number contains an excellent paper on the subject by Mr. John Darch, a member of the Illuminating Engineering Society, who deals with the question of glare in hospital wards, natural lighting, artificial lighting for operation theatres, etc. Reports of the discussion on the paper, in which well-known eye specialists took part, follow, and altogether the number is well worthy of perusal. The cost of the number is 1s. 6d. net, and it may be obtained from the Illuminating Engineering Publishing Company, Ltd., 31, Victoria Street, London, S.W. 1.

A. D. S.

Reviews.

BIRDS AND BLOSSOMS—A CALENDAR FROM NATURE. By R. H. Firth. London : Bale, Sons and Danielsson, Ltd. 8 in. × 11 in. Pp. 32. Four coloured plates. Price 2s. 6d. net.

This is the latest production from the pen of a well-known contributor to this journal, namely, Colonel Sir Robert Firth, and consists of a series of Nature sketches, arranged according to the calendar months, with a large number of black and white drawings of birds and beasts and four coloured plates of wild flowers. The ever changing seasons of the year are described by the author in his usual vigorous and inimitable style. Each month of the year is considered separately, with appropriate comments on the birds and flowers we should look out for. Under January, we note that he calls attention to the fact that even in that bleak month the autumn cyclamen may be found in sheltered woods alongside his hardier brother of the winter and spring.

The plates of wild flowers are good, but the flowers are not described nor alluded to individually on the plates, which seems a pity. The letterpress is charmingly written in an easy interesting style which carries the reader wholeheartedly into the fields, woods and other places which evidently the writer loves well. The Calendar is attractively bound in an ornamental paper cover, and for those who seek an appropriate gift to make at this or any other season, they cannot do better than ask for "Birds and Blossoms," on whose welcome appearance we congratulate both publishers and author. Altogether, a delightful production and astonishingly cheap.

A COMPENDIUM OF THE PHARMACOPŒIAS. By C. J. S. Thompson. Sixth Edition. London : John Bale, Sons and Danielsson, Ltd., 1922. Pp. 398. Price 10s. net.

This book is written entirely for pharmaceutical chemists, and contains a mass of miscellaneous information, with a table of contents and a very useful index.

Well printed on good paper and nicely bound, it should stand plenty of wear ; there are no printers' errors and the publishers' part is well done.

The analytical part comprises the analysis of milk and urine, and the whole is quite satisfactory for the purpose in view. There is one slight error in the milk standards ; the Somerset House standards for milk were actually made by the Board of Agriculture, not by Somerset House. The test for preservatives could be made much easier and more exact by a selection of more up to date methods, as for instance the turmeric paper test for boric acid. In urine analysis, the standard hypobromite method for the estimation of urea is not given and in Fowler's test the pharmacist is recommended to use Labarraque's solution, of which no details appear to be given ; it is certainly not mentioned in the index under that name. The table of analyses of typical wines by various authorities is not very correct—the figures for the amount of sugar in port are very much lower than those given in the report of the Lancet Analytical Commission, 1907. The addition of a section on water analysis might have been useful to some pharmacists, who still receive samples to examine, and the pages on sterilization of water in the field are more of historical interest than of present value. We are also surprised to note the omission of N.C.I. powder amongst formulæ for the prevention of body vermin.

S. E.

THE CHEMICAL EXAMINATION OF WATER, SEWAGE, FOODS AND OTHER SUBSTANCES.
By J. E. Purvis and T. R. Hodgson. Cambridge University Press, 1922.
Second Edition. Price 20s.

The second edition of a book by two such well known authors calls for little criticism. The volume is one of the best of its kind, up to date and containing a mass of useful material. On the whole the methods are well explained, but the authors' description of the important Marsh's method for determination of arsenic in beer is inadequate and the wide use of Haldane's apparatus for estimation of carbon dioxide in air justifies much more than the brief dozen lines allotted to it.

It is a book which will be used more by Medical Officers of Health and Public Health Students than by analysts, and in a future edition the authors would be well advised, firstly, to amplify, even more than they have already done, those portions of the book dealing with the interpretations of analyses, and, secondly, where several methods of obtaining a result are described, to indicate the one which they consider most generally useful. We would also suggest that in a book of this kind a detailed description of some experimental work done upon sea water and sewage possesses scarcely sufficient relative importance to justify the appropriation to it of some fifteen pages.

The book can be recommended to officers working for the D.P.H., provided they obtain advice in the selection of those portions necessary for examination purposes.

S. E.

REMINISCENT SKETCHES, 1914 to 1919. By Members of Her Majesty Queen Alexandra's Imperial Nursing Service. London: John Bale, Sons and Danielsson, Ltd. Pp. vi + 80.

This small book has been printed for private circulation amongst the nurses who served during the late war, and is intended to give some idea of the work of the army nurse in connexion with the expeditionary forces overseas.

In the preface, written by Miss Beadsmore Smith, C.B.E., R.R.C., Matron-in-Chief of the Q.A.I.M.N.S., we are told that in 1914 there were only 300 trained nurses of all ranks in the Service, and a reserve of 800, consisting of 200 reserve nurses, available at twenty-four hours' notice, and 600 nurses promised from civil hospitals in the event of war. From 1914 to 1918, 10,404 nurses were enrolled in the Q.A.I.M.N.S. Reserve, and in addition there were 8,495 nursing members of Voluntary Aid Detachments serving in military hospitals at home and abroad. There were 195 deaths, and 45 nurses were killed or drowned through enemy action or accidentally.

The sketches are charmingly written; they give vivid pictures of the various theatres of war, and the pervading note is one of quiet heroism and unassuming work in most trying circumstances. Difficulties and dangers are made light of; the nurse's first thought is always for her patients.

The description of life on an ambulance train in 1914 brings back our first experience of hospital trains made up of French carriages without any means of intercommunication. Many a nurse risked her life crawling along the footboards from carriage to carriage; the practice was strictly forbidden, but frequently it was an absolute necessity in the interests of the patients. The trains went right up to the front and were frequently shelled; they received the wounded covered with mud, straight from the battlefield. The "khaki" trains which replaced the old ambulance trains were beautifully fitted up, and had excellent accommodation for both patients and the nursing staff.

The story of the hospital ship *Anglia*, which brought home H.M. King George after his accident in France, and which was subsequently blown up by enemy action, when conveying to England some 500 armless and legless patients, is vividly told.

The other sketches are also of absorbing interest, and we feel sure that this record of our nurses' work, of which too little has been heard, will make a great appeal to all who served during the late war.

A HOSPITAL LETTER-WRITER IN FRANCE. By May Bradford. London: Methuen and Co. Small 8vo, pp. 108.

This is a book with an atmosphere, namely, that of the wards of our great base hospitals in the late war; not the atmosphere familiar to the professional workers in those wards, but the atmosphere which existed when their work was done, when the stricken were able to lay bare their inmost thoughts, feelings, hopes and desires to kindly and sympathetic women anxious to play the part which the purely professional worker had neither the time nor opportunity to fulfil. Such a kindly and sympathetic woman was the author of this book, who for four and a half years acted as an officially accredited hospital letter-writer; writing letters for those unable to do so, ferreting out unrecorded names and addresses, smoothing personal and family difficulties for those unable to write, receiving confidences and comforting, by timely and appropriate messages, the anxieties and griefs of relatives far away. The book is charmingly written, free from egoism, but full of pathetic and humorous stories of intimate experiences with that strange but really lovable creature the British soldier. Few books on the war can appeal more to the thoughtful than this little volume. It brings home to one the tragedy and the pathos of war, and it focuses attention fittingly on a little considered rôle which some good women played in the great struggle of 1914-18. Among these good women was Lady Bradford and we congratulate her on this story of her experiences.

R. H. F.

Correspondence.

THE INTERNATIONAL CONGRESS OF MILITARY MEDICINE AND PHARMACY.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—With reference to the notes on the above subject in the June number of the Journal, information has now been received that the Second Congress will be held at Rome from May 28 to June 2, 1923.

The official journal of the Congress is *Giornale di Medicina Militare*, Palazzo del Ministero della Guerra, Via Venti Settembre, Roma, to which reference may be made for particulars regarding the Congress.

The subscription for medical officers attending the Congress has been fixed at 25 francs, and for members of their family 15 francs.

I am, etc.,

A. D. STIRLING, .

Major, Royal Army Medical Corps.

October 18, 1922.

INDEX TO VOLUME XXXIX.

C.N. = Clinical and other Notes.
C.L. = Current Literature.

	PAGE		PAGE
Acari, endoparasitic, as a cause of urinary diseases, by Lieutenant-Colonel J. Mackenzie	339	Catarrhal phase, by Major H. Gall	109, 188
Alastrim in Jamaica, notes on, by Major W. F. M. Loughnan	C.N. 378	Cerebral tumour, by Major J. T. D. Douglas	C.N. 467
Aneurysm, of the basilar artery, a case of, by Captain E. W. Wade	C.N. 216	Chlorinated water, action of, on galvanized-iron tanks, by Major N. V. Lothian and Captain A. R. Ward	163
Anthrax	C.L. 315	Chlorination of milk, by Captain R. A. Mansell	C.N. 372
Appendix vermiform, clinical aspect of disease, by Lieutenant-Colonel H. M. Perry	419	Citrus industry in South Africa, by Major-General H. Carr, letter from	319
Aumonier, F. S., and Major S. Elliott, note on stabilized bleaching powder for tropical use	C.N. 459	Congress, the International, of Military Medicine and Pharmacy, by Major A. D. Stirling, letter from	473
<i>Bacillus suipestifer</i> , infection of man by an organism allied to (hog cholera), by Lieutenant-Colonel J. Mackenzie	51	CORRESPONDENCE—	
Balfour, Andrew, the outlook of tropical hygiene	386	Prophylaxis of malaria in 1817, by Major E. K. Campbell	161
Basilar artery, a case of aneurysm of the, by Captain E. W. Wade	C.N. 216	The citrus industry in South Africa, by Major-General H. Carr	319
Bayer 205, the new chemical therapeutic agent	C.L. 469	The International Congress of Military Medicine and Pharmacy, by Major A. D. Stirling	473
Bio-aceration of Sewage, some data on the, by Captain H. N. Stafford and Captain A. R. Ward	43	The filter passer in influenza, by M. H. Gordon	399
Bleaching powder for tropical use, by F. S. Aumonier and Major S. Elliott	C.N. 459	Cummins, Colonel S. L., prevention of tuberculosis	73
Boot, improved type of, by L. D. Fairweather	171	Diphtheria, experiences with the Schick test and active immunization against	C.L. 149
Bourke, J. F., the medical aspect of an eighteenth century battalion	285	Douglas, Major J. T. D., three unusual cases in one month	C.N. 466
Boyd, Major J. E. M., travelling in Mesopotamia	70	Dyspituitarism, notes on the three cases of, by Major W. L. Webster	C.N. 59
Bruce, Captain, impromptu Cæsarean section at Kasauli	C.N. 222	ECHOES OF THE PAST—	
Burns, Captain J. C., a march into Kurdistan during the rebellion of 1919	354	Notice of a form of ulcer prevalent at Delhi, or Delhi boil, by A. H. Fraser	138
Cæsarean section at Kasauli, impromptu, by Captain Bruce	C.N. 222	EDITORIAL—	
Carbolized vaccine in rabies in Irak and its treatment, by Lieutenant-Colonel A. E. Hamerton	403	Shell shock	450
Carr, Major-General H., the citrus industry in South Africa, letter from	319	Eighteenth century battalion, the medical aspect of an, by Captain J. F. Bourke	285
Campbell, Major E. K., prophylaxis of Malaria in 1817, letter from	161	Elliott, Major S., stabilized bleaching powder for tropical use	C.N. 459
		Endoparasitic acari as a cause of urinary diseases, by Lieutenant-Colonel J. Mackenzie	339
		Ensor, Colonel H., Royal Army Medical Corps staff tour in Egypt	330, 424
		Equipment, sanitary, required for a British training camp in India, by Captain J. B. Fotheringham	C.N. 217

	PAGE		PAGE
Eruptive fever, a series of cases of an unusual, by Major J. E. H. Gatt C.N.	64	Hog cholera, by Lieutenant-Colonel J. Mackenzie	51
Fairweather, S. D., modern footwear as a cause of fatigue, muscular rheumatism and flat-foot	171	Hospitals, the lighting of C.N.	470
Filter passer of influenza, by Lieutenant-Colonel M. H. Gordon	1, 399	Hughes, Lieutenant-Colonel G. W. G., the next war C.N.	300
Filter-passing and "ultramicroscopic" viruses, are the active principles living organisms or enzymes, by H. M. Woodcock	243	Hypophyseal infantilism, Lorain type of, by Major W. L. Webster C.N.	59
Firth, Colonel Sir Robert, fragments ..	261	Immunization, general immunity by local C.L.	315, 467
Flat-foot, modern footwear as a cause of fatigue, muscular rheumatism and, by S. D. Fairweather	171	Indian kala-azar, the occurrence of leishmania in, by Lieutenant-Colonel H. M. Perry	323
Fotheringham, Captain J. B., sanitary equipment required for a British training camp in India C.N.	217	Infantilism, Lorain type of, by Major W. L. Webster C.N.	59
Fragments, by Colonel Sir Robert Firth ..	261	Infantry division, medical arrangements of an, in open warfare, by Colonel R. S. Hannay	348
Fraser, A. H., notice of a form of ulcer prevalent at Delhi	138	Influenza and catarrh, experience of prophylactic inoculations .. C.L.	79
French Medical Services of the 15th French Army Corps, by Major A. D. Stirling	C.N. 460	Influenza at the Curragh Camp, 1921, by Major J. E. H. Gatt C.N.	130
Gall, Major H., the catarrhal phase ..	109, 188	Influenza, skin eruptions in .. C.L.	239
Gatt, Major J. E. H., cases of an unusual erupted fever C.N.	64	Influenza, the filter passer of, by Lieutenant-Colonel M. H. Gordon ..	1
Gatt, Major J. E. H., influenza at the Curragh Camp, 1921 C.N.	130	Irak, rabies in, and its treatment by carbolized vaccine, by Lieutenant-Colonel A. E. Hamerton	403
Gordon, Lieutenant-Colonel M. H., the filter passer of influenza	1	Jamaica, alastrim in, by Major W. F. M. Loughnan	C.N. 378
Gordon, M. H., the filter passer of influenza, letter from	399	Jaundice, report on an epidemic of, at Port Sudan, by Captain W. T. Whitehead	C.N. 294
Grattan, Colonel H. W., medical organization, with special reference to the transportation of wounded in open warfare	30	Kala-azar, Indian, the occurrence of leishmania in, by Lieutenant-Colonel H. M. Perry	323
Gregg, Major R. G. S., notes from a D.A.D.P. at a home station	180	Krzyszskowsky, Professor Constantino, the principal diseases prevalent in the Russian Army during the period 1914-1916 and the struggle against infectious disease	120, 198
Hæmatophagy and hæmetaboly as a normal function of various types of tissue-cell, by H. M. Woodcock ..	14	Kurdistan, march into, during the rebellion of 1919, by Captain J. C. Burns ..	354
Hamerton, Lieutenant-Colonel A. E., rabies in Irak, and its treatment by carbolized vaccine	403	Landry's paralysis, by Major J. T. D. Douglas	C.N. 466
Hamilton, Major C. S. P., some clinical details from a depot hospital .. C.N.	65	LECTURES—	
Hannay, Colonel R. S., medical arrangements of an infantry division in open warfare	348	The outlook in tropical hygiene, by Andrew Balfour	386
Harold, Major C. H. H., the euglobulin group and its relationship to the Wassermann reaction	83	The prevention of tuberculosis, by Colonel S. L. Cummins	73
Henoch's purpura, by Major J. T. D. Douglas	C.N. 466	Leishmania in Indian kala-azar, the occurrence of, by Lieutenant-Colonel H. M. Perry	323
		Lighting of Hospitals C.L.	470

	PAGE		PAGE
Lothian, Major N. V., the action of chlorinated water on galvanized-iron tanks	163	Rabies in Irak, its treatment by carbolized vaccine, by Lieutenant-Colonel A. E. Hamerton	403
Loughnan, Major W. F. M., notes on alastrim in Jamaica C.N.	378	REVIEWS—	
MacArthur, Lieutenant-Colonel, the elementary principles of zoological nomenclatures	441	A compendium of the pharmacopœias, by C. J. S. Thompson	471
Mackenzie, Lieutenant-Colonel J., endoparasitic acari as a cause of urinary diseases	339	A guide to urinary diseases, by A. Abrahams	317
Mackenzie, Lieutenant-Colonel J., infection of man by an organism closely allied to <i>Bacillus suispestifer</i> (hog cholera)	51	A hospital letter-writer in France, by Major Bradford	473
Malaria, prophylaxis of, in 1817, by Major E. K. Campbell, letter from	161	A study of intestinal stasis, by Dr. J. C. Watt	159
Manifold, Major J. A., infecting pneumococcus in cerebrospinal fluid, diagnosis of type by precipitin tests applied to the spinal fluid C.N.	223	Artificial limbs and amputation stumps, by E. Muirhead Little	239
Mansell, Captain R. A., the chlorination of milk	372	Birds and blossoms, by R. H. Firth	471
March into Kurdistan, during the rebellion of 1919, by Captain J. C. Burns	354	De arte phisicali et de Cirurgia of Master John Arderne, Surgeon of Newark, dated 1412	398
Medical arrangements of an infantry division, by Colonel R. S. Hannay	348	First-aid X-ray atlas of the arteries, by H. G. Orrin	241
Medical aspect of an eighteenth century battalion, by Captain J. F. Bourke	285	Functional nervous disorders, by Donald E. Core	317
Medical organization in open warfare, by Colonel H. W. Grattan	30	Guide to a second-class certificate, by F. P. R.	240
Mesopotamia, travelling in, by Major J. E. M. Boyd	70	Handbook for the limbless, by G. Howson	240
Milk, chlorination of, by Captain R. A. Mansell	372	Manual of physio-therapeutics, by T. D. Luke	240
Muscular rheumatism flat-foot, and fatigue, modern footwear as a cause of, by S. D. Fairweather	171	Medical Services during the war—vol. i, diseases of the war	156
Parotid tumour, a case of, by G. Woodforde	134	Modern methods in the diagnosis and treatment of renal disease, by H. MacLean	241
Pellagra	238	Reminiscent sketches, 1914-1919, by Members of Her Majesty Queen Alexandra's Imperial Military Nursing Service	472
Perry, Lieutenant-Colonel H. J. M., clinical aspects and pathology of primary malignant disease of the vermiform appendix	419	Ten post-graduate lectures delivered before the Fellowship of Medicine at the House of the Royal Society of Medicine	160
Perry, Lieutenant-Colonel H. J. M., diagnosis of type of infecting pneumococcus in cerebrospinal infections by precipitin tests applied to the spinal fluid	223	The causation of sex in man, by E. R. Dawson	397
Perry, Lieutenant-Colonel H. M., the occurrence of leishmania in Indian kala-azar	223	The chemical examination of water, sewage, foods and other substances, by J. E. Purvis and T. R. Hodgson	472
Pneumococcus, infecting, in cerebrospinal infections, diagnosis of type by precipitin tests applied to the spinal fluid, by Lieutenant-Colonel H. J. M. Perry and Major J. A. Manifold C.N.	223	The mechanism of the brain and the function of the frontal lobes, by Professor L. Bianchi	158
		The practice of medicine in the tropics, by W. Byam and R. G. Archibald	241
		The principles of preventive medicine, by R. T. Hewlett and A. T. Nankivell	160
		The Royal Fusiliers in the Great War, H. C. O'Neill	316
		The surgical exposure of the deep-seated blood-vessels, by J. Fiolle and J. Delmas	159

	PAGE		PAGE
Ronayne, Lieutenant-Colonel C. R. L., around the world.. . . .	140, 224, 303	Tumour, a case of parotid, by G. Wood- forde	C.N. 134
Russian Army, and the struggle against infectious diseases, during 1914-1916, by Constantino Krzyszkousky ..	120, 198	Ulcer prevalent at Delhi, or Delhi boil, notice of a form of, by A. H. Fraser ..	138
Sachs-Georgi reaction in the Tropics, the technique of, by W. Leslie Webb ..	98	Urinary diseases, endoparasitic acari as a cause of, by Lieutenant-Colonel J. Mackenzie.. .. .	339
Sanitary equipment required for a British training camp in India, by Captain J. B. Fotheringham	C.N. 217	Vaccine, carbolized, rabies in Irak, and its treatment by, by Lieutenant-Colonel A. E. Hamerton	403
Senescence and senility, by Major R. J. C. Thomson and Major R. E. Todd ..	273	Vermiform appendix, the clinical aspects and pathology of primary malignant disease of the, by Lieutenant-Colonel H. J. M. Perry	419
Sewage, some data on the bio-aeration of, by Captain H. N. Stafford and Captain A. R. Ward	43	Wade, Captain E. W., a case of aneurysm of the basilar artery	C.N. 216
Shell-shock	450	War, the next, by Lieutenant-Colonel G. W. G. Hughes.. .. .	C.N. 300
Stafford, Captain H. N., some data on the bio-aeration of sewage	43	Ward, Captain A. R., some data on the bio-aeration of sewage	43
Smallpox epidemic in Basle, 1921 ..	C.L. 237	Ward, Captain A. R., the action of chlorinated water on galvanized-iron tanks	163
Smallpox, outbreak of, occurred in England	C.L. 238	Wassermann reaction, the euglobulin group and its relationship to the, by Major C. H. H. Harold	83
Staff tour in Egypt, a Royal Army Medical Corps, by Colonel H. Ensor ..	330, 424	Webb, W. Leslie, original Sachs-Georgi reaction in the tropics as an indication for diagnosis and treatment of syphilis ..	98
Stirling, Major A. D., International Congress of Military Medicine and Pharmacy, letter from	473	Webster, Major W. L., notes on three cases of dyspituitarism	C.N. 59
Stirling, Major A. D., Medical Services of the 15th French Army Corps ..	C.N. 460	Whitehead, Captain W. T., report on an epidemic of jaundice at Port Sudan ..	C.N. 294
Tanks, galvanized-iron, action of chlor- inated water on, by Major N. V. Lothian and Captain A. R. Ward	163	Wilson, Major R. C., the land of Cream and —?	382
Tartar emetic, notes on a case treated by intravenous injections of, by Major B. H. Y. Dunbar	C.N. 298	Winter, Captain H. G., the duties of a deputy assistant director of medical services at the present day	207
Thomson, Major R. J. C., senescence and senility	273	Woodcock, H. M. Are the active prin- ciples of filter-passing and "ultra microscopic" viruses living organisms or enzymes?	243
Todd, Major R. E., senescence and senility	273	Woodcock, H. M., hæmatophagy and hæmetaboly as a normal function of various types of tissue-cell	14
Tour, staff in Egypt, a Royal Army Medical Corps, by Colonel H. Ensor ..	330, 424	Woodforde, G., a case of parotid tumour ..	C.N. 134
Transportation of wounded in open war- fare, by Colonel H. W. Grattan ..	30	Wounded, transportation of, in open war- fare, by Colonel H. W. Grattan ..	30
TRAVEL :—		Zoological nomenclature, the elementary principles of, by Lieutenant-Colonel W. P. MacArthur	441
Around the world, by Lieutenant- Colonel C. R. L. Ronayne	140, 224, 303		
The land of cream and —?, by Major R. C. Wilson	382		
Travelling in Mesopotamia, by Major J. E. M. Boyd	70		
Tuberculosis, treatment of, by Colonel S. L. Cummins	73		
Tularemia, a disease hitherto undescribed C.L.	80		

Notices.

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